ISSN 2047-9638
Issue 7- June 2010

KING'S College LONDON

SOCIAL CARE WORKFORCE RESEARCH UNIT

Social Care Workforce Periodical

MODELLING PAY IN ADULT CARE USING LINEAR MIXED-EFFECTS MODELS

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June 2010

ISSUE **7**
SOCIAL CARE WORKFORCE RESEARCH UNIT
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About *Social Care Workforce Periodical*

The *Social Care Workforce Periodical* (SCWP) is a regular web-based publication, published by the Social Care Workforce Research Unit, King's College London. SCWP aims to provide timely and up-to-date information on the social care workforce in England. In each issue, one aspect of the workforce is investigated through the analysis of emerging quantitative workforce data to provide evidence-based information that relates specifically to the social care workforce in England. The purpose is to share emerging findings with the social care sector to help improve workforce intelligence. Such updates are useful in highlighting specific issues for further analysis and to inform workforce policy. The first few issues of *Social Care Workforce Periodical* provide in-depth analyses of the latest versions of the National Minimum Data Set in Social Care (NMDS-SC). We welcome suggestions for topics to be included in future issues.

About the author

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Acknowledgments

The author is most grateful to Skills for Care for providing the latest NMDS-SC data files. Particular thanks are due to David Griffiths, Christine Eborall and William Fenton for their support and assistance, and to colleagues at the Social Care Workforce Research Unit. This work is funded under the Department of Health Policy Research Programme support for the Social Care Workforce Research Unit at King's College London. The views expressed in this report are those of the author alone and should not necessarily be interpreted as those of the Department of Health or Skills for Care.

Executive Summary

In the last Issue of *Social Care Workforce Periodical*, we showed that the adult social care sector is characterised by two distinct pay layers, with professionals and managers at the top end of the pay ladder within the sector and direct care and 'other' workers earning substantially less[1]. The initial analyses show that pay rates appear to be influenced by a number of factors at the level of the employer (the places where people work) as well as by workers' individual characteristics. We observed variations relating to sector and type of setting; and furthermore, gender and ethnicity pay-gaps were visible among groups of staff doing similar work.

The literature supports the view that pay does not operate at a single level and is usually affected by a number of factors operating on different levels, for example by personal and employer characteristics simultaneously. Furthermore, personal characteristics such as ethnicity and gender usually explain only small elements of pay variation. Thus, in this *Issue* we employ mixed-effect modelling techniques to examine the association of different characteristics affecting pay rates while accounting for other variables acting at different hierarchical levels. The 'random' elements of the models attempt to estimate the proportion of pay-variance attributed to 'unobserved' factors on each level. For example, how much total pay-variance, not explicable measured by variables in a model, is attributed to unobserved employer factors while accounting for sector and region? The 'fixed' parts of the models estimate the relationship between different measured variables and pay rates. Given that pay rates are generally different for each group of workers, we built separate models for each of the main four job role groups in the sector: namely, direct care workers, managers/supervisors, professionals and 'other' job roles.

Chart 1 simplifies the nesting effect on pay; it presents a model whereby individual workers work for different employers, which in turn are nested within different sectors, with these sectors nested within three main regions in England (North, Midlands and South). Every worker has separate characteristics (such as age, gender and ethnicity), and so too does each employer (such as management style, internal dynamics and structure). Similarly, each of the main sectors in social care (local authority, private, voluntary) have their own internal factors that are likely to affect individual workers' pay levels; and as Issue 6 showed, regional pay-variations also exist so it is important to consider their effect as well.

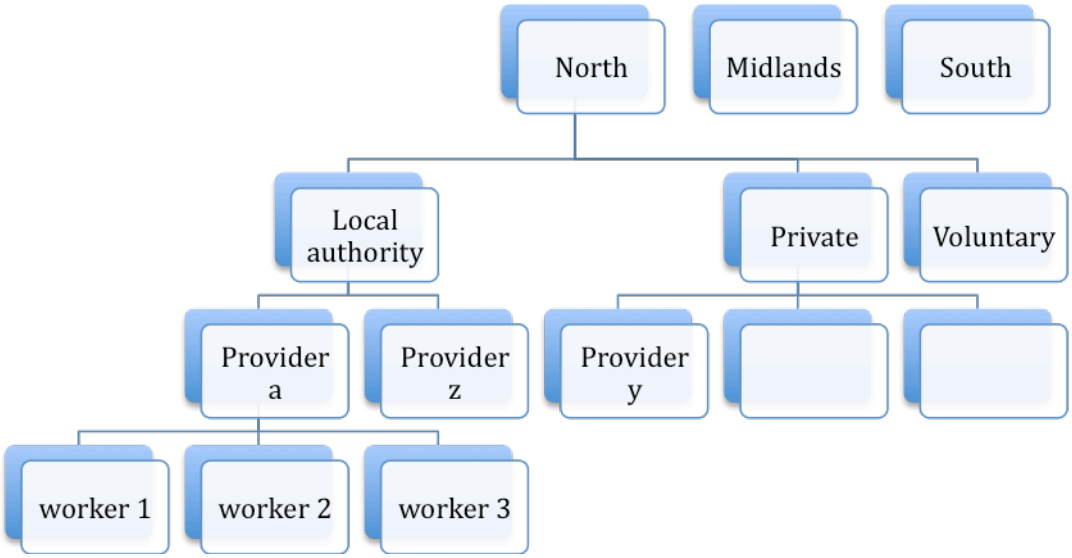
The findings of the four mixed-effect models indicate that the relative influences of each level of these hierarchies (provider, sector and region) on pay are distinctive for each group of workers. Unobserved characteristics of individual employers account for 22 percent to 55 percent of total pay-variance, after both

[1] The data excluded manager-owners, who may be receiving highly remunerated Directorships and/or have substantial share holding and capital investments in the sector

sector- and region-level effects have been accounted for. Other unmeasured characteristics (not related to employer, sector or region) are estimated to be responsible for three-quarters of individual pay-variance among managers and supervisors in adult care; possibly reflecting greater variation in the levels of experience, responsibilities and accountability among individual managers/supervisors. The same group of workers also have the highest within group variability in terms of pay. While, the proportion of variance attributed to 'unmeasured' factors is only 30 percent among direct care workers and just above half of the variance among professional staff and workers holding 'other' job roles (54% and 57%).

Pay-variations attributed to regional effect are highest among direct care workers, at 10.7 percent, followed by 'other' job roles at 6.1 percent of the variance. The component of total pay-variance attributed to regional effects was considerably higher than that attributed to the sector for all job roles, except for 'other' jobs where region and sector have almost identical effects (6.1% and 6.3%). Variations in pay levels are highest among manager/supervisor job roles, and lowest for direct care workers.

Chart 1 Simplified visualization of the nested relationship of different structures on individual pay levels within one region



In terms of the estimated associations between measured characteristics and pay levels, a number of important results emerge. On the personal level, age is significantly associated with pay levels only among professional workers in adult social care. Being older than average has a significantly positive impact on pay among this group: in other words, professionals get paid more for seniority, experience or age. Gender has a significant association with pay levels for both managers/supervisors and professional workers, the two job groups with the highest median pay rates. Women earn significantly less than men among these two groups. In other words, the pay gap between female and male professionals is less pronounced than that for managers and supervisors. Gender pay-gaps are

a particular concern, as they are only significant at the high end of pay scales within the sector (namely, among professional staff and those with managerial/supervisory roles); although the magnitude of this difference is much lower than that related to sector (β=-0.123, p=0.007 and β=-0.469, p<0.001 respectively).

Ethnicity is also significantly associated with pay levels among direct care workers and professional workers: workers from BME groups earn significantly less than White workers. This appears to operate at both ends of the pay scale in the care sector. However, for the professional group, the variations are almost attributable to the large concentration of 'Asian' workers among registered nurses (often working in care homes and of course not for the NHS) who earn, on average, less than other professional workers such as social workers or occupational therapists.

Of the measured macro (large scale) level variables, it is the sector that matters most - sector has the highest level of association, and its effect is largest in magnitude, on pay rates for all job roles. Pay rates in the private sector are significantly lower than those in local authorities, particularly among direct care workers. The type of services provided is also significantly associated with pay rates, particularly for direct care and 'other' job roles. Those working in adult community care settings earn significantly more than the average for this job role group, followed by adult day care workers, while direct care workers in residential or domiciliary care settings earn significantly less. The type of care service, however, is not significantly associated with pay rates among professional staff such as social workers and occupational therapists.

The current analyses provide, for the first time, an almost complete picture of the levels of pay in the care sector and factors influencing them, separated for different job role groups (with the cautions that are necessary when considering the NMDS-SC, see below). Public-private, as well as voluntary, pay variations are considerable within the care sector. Such findings are consistent with research in other sectors in more economically developed countries (MEDC) (for example, Lucifora and Meurs 2004, Melly 2005). Pay in the care sector demonstrates the expected relationship between skill level and pay; public sector pay is significantly higher for those in low-skilled jobs, although the difference is narrower for workers in higher-skilled positions. However, given that the share of the independent sector (private and independent) provision in the adult care sector is considerable, at around 70 percent (Eborall and Griffiths 2008), a relatively small proportion of workers benefit from the better pay levels in local authorities.

The majority of adult domiciliary and residential care is provided by the private sector, while both community care and adult day care settings are dominated by local authority provision (Eborall and Griffiths 2008). The findings showing that workers, particularly direct care workers, employed in the former settings earn significantly less than those in the latter two settings are not surprising, given the sector-specific variations noted above. The interaction between sector and

type of service is particularly significant for direct care workers, who are already at the lower end of pay levels within the care sector.

Introduction

As discussed in Issue 6 of *Social Care Workforce Periodical*, pay in the care sector forms a cornerstone of debates about social care. The sector has long been characterized by low pay, which has produced a number of effects both on the position of the sector in the labour market and on recruitment and retention issues. The first stage analysis of pay levels presented in Issue 6 highlighted some important differentials and trends. Analysis suggested the existence of a double-layered workforce, encompassing a minority (18%) of professionals and staff in managerial roles, who are paid well above the majority of direct care workers and workers in 'other' roles, with evident regional variations in pay levels. Overall, median pay rates are better in local authorities or local authority-owned provision, particularly for managers and supervisors. Some clear variations were observed in relation to both employer and personal characteristics. For example, type of service, gender and ethnicity appeared to have some effect on pay level among almost all staff groups. As with other sectors, some differentials in male-female and White-BME pay levels exist in the care sector.

However, a number of these characteristics interact, operating on a number of different hierarchical levels. To investigate such a multiplicity of factors operating on different levels linear mixed-effect regression models were used. This approach allows us to measure the variation related to unobserved characteristics, on all hierarchical levels (individual, employer, sector, region); and to separate the specific effect of different personal characteristics on pay. The structure of the NMDS-SC data allows the use of such a technique specifically because of the employer-worker match within the data. All workers' data are nested within employers' data, as well as sector and region, and these levels are identifiable through the NMDS-SC. Previous research in the US showed that a significant part of any given pay differential is due to unobserved characteristics both on the worker and employer levels (Woodcock 2008). Here, we aim to examine the effect of both 'measured' characteristics, such as age, gender and ethnicity, and of 'unmeasured' characteristics, on different levels. Mixed-effect models allow the identification and attribution of specific proportions of pay variation to different levels, such as provider, sector and region. They provide us with rich information while enhancing the understanding of observed pay differentials.

Existing research indicates that predominantly female occupations have lower wage levels than 'male' dominated jobs. This may be related to the concentration of women in low-paying jobs or the perception and value placed by employers on female-dominated jobs (England et al. 2007). However, as we showed in Issue 6, the adult social care sector operates with two pay tiers, as professionals and managers/supervisors earn considerably more than direct care workers and 'other' workers. Thus, it is important to investigate variations in pay within each group of workers and identify which factors, at what hierarchical level, are significant in relation to levels of pay.

The current Issue of the *Social Care Workforce Periodical* builds on the pay analysis presented in Issue 6, taking the investigation a step further in an attempt to examine the complexity and interactions of pay variations within the adult social care sector. The analysis is based on a total of 88,982 records of adult care workers, identified through the process detailed in Issue 6; it additionally excludes any missing values for the main variables investigated in the analysis, as detailed in the 'Methods' section.

Methods

Mixed-effects models are the most appropriate for representing hierarchical data where observations are correlated, such as pay levels. Workers are grouped by employers, under the assumption that every employer has a pay policy, which affects all workers on its pay scales. Moreover, different employers are grouped within sectors, which in turn may vary in their regulations and policies. There are also some regional effects; local demographics, as well as labour market dynamics, may have an effect on wages. In statistical terms, ignoring this grouping effect would lead to inaccurate results due to statistical errors when treating data as independent while they are not (or pseudoreplication, resulting from conducting an analysis on data assumed to have more freedom than is actually the case). Effectively, an ordinary linear model would not be accurate, being likely to report terms as significant where they in fact are not. A major benefit of accounting for the hierarchical nature of data, as in mixed-effect models, is the ability to identify levels of variation at different levels of hierarchy; as we will see in the following models. Mixed-effects models also deal with omitted variable bias by using only the variation within a group to estimate the parameters. This controls for all the stable characteristics of a certain group that are not measured in the dataset; or, to put it another way, characteristics that are related, for example, to certain sectors, but which are not measured in the NMDS-SC data (such as level of regulation).

Here we use separate mixed-effect models for each of the four groups of workers: namely, direct care workers, professional workers, managers and supervisors and ancillary staff.[2] For each group we started with a simple model, with employer effects set as random and workers' age set as a fixed effects. We centered the age around the mean age of each group of workers. We then used a forward step-wise process to introduce to the model additional characteristics and interactions and tested the improvement in the overall model using AIC (Akaike information criteria) and BIC (Bayesian information criteria) to select the best model (Akaike 1974, Schwartz 1978). We also added different hierarchical levels, nesting employers within sectors within regions. Non-significant factors, which did not improve the overall model, were dropped before adding new factors. The final model for each group of workers presents the best model as determined by both AIC and BIC. The analyses are produced using NMDS-SC, end of December 2009 release, for records updated during 2009. Full discussion and description of the extraction process for pay-related data are provided in Issue 6 of this *Periodical* (Hussein 2010); and a brief summary is provided latter in this section and in Appendix A. The analyses are performed

[2] Grouped as: 1. 'Managers/supervisors': senior management, middle management, first line manager, register manager, supervisor, managers and staff in care-related jobs; 2. 'Direct care': senior care worker, care worker, community support, employment support, advice and advocacy, educational support, technician, other jobs directly involving care; 3. 'Professional': social workers, occupational therapists, registered nurse, allied health professional, qualified teacher; 4. 'Other': administrative staff, ancillary staff, and other job roles not directly involving care.

using an extension to Laird–Ware formulation for single-level LME in R statistical environment (R Development Core Team 2007).

Formulation of the linear mixed-effect model

The formulation of a (multilevel) linear mixed-effect model with two nested levels of random effects can be written in a matrix format as follows (an adaptation of Pinheiro and Bates [2000] that extends Laird–Ware formulation for single-level LME [Laird and Ware 1982]).

$$y_{ij} = X_{ij}\beta + Z_{i,j}b_i + Z_{ij}b_{ij} + \varepsilon_{ij},$$
$$i = 1,\ldots,M, \quad j = 1,\ldots,M_i$$
$$b_i \sim \mathrm{N}(0,\Psi_1), \quad b_{ij} \sim \mathrm{N}(0,\Psi_2), \quad \varepsilon_{ij} \sim \mathrm{N}(0,\sigma^2 I).$$

Equation 1

Where:
y_{ij} are the response vectors at the innermost level of grouping ,length n_{ij} M is the number of first levels of groups, region.
M_i is the number of the second level of groups, employers within each region.
X_{ij} are the fixed effects model matrices. Size $n_{ij} \times p$
b_i is the first-level random effect (Region) of length q_1
b_{ij} is the second-level random effect (Employer) of length q_2
$Z_{i,j}$ are the first-level random effects model matrices. Size $n_i \times q_1$
Z_{ij} are the second-level random effects model matrices. Size $n_i \times q_2$

It is assumed that:
b_i are independent for different i
b_{ij} are independent for different i or j and independent of b_i
ε_{ij} are independent for different i or j and independent of the random effects.

We started the analysis using the above formulation, accounting for 2 nested random effects (Employer within Region); we then moved to 3 levels of nested random effects (Employer within Sector within Region)

This formulation can be extended to account for 3 nested levels, as follows:

$$y_{ijk} = X_{ijk}\beta + Z_{i,jk}b_i + Z_{ij,k}b_{ij} + Z_{ijk}b_{ijk} + \varepsilon_{ijk},$$
$$i = 1,\ldots,M, \quad j = 1,\ldots,M_i, \quad k = 1,\ldots,M_{ij},$$
$$b_i \sim \mathrm{N}(0,\Psi_1), \quad b_{ij} \sim \mathrm{N}(0,\Psi_2), \quad b_{ijk} \sim \mathrm{N}(0,\Psi_3), \quad \varepsilon_{ijk} \sim \mathrm{N}(0,\sigma^2 I).$$

Equation 2

Data, variables and levels in the models

Here, in this report, we use the NMDS-SC pay data provided by employers who completed the National Minimum Data Set for Social Care (NMDS-SC) database

up until the end of 2009 to investigate up-to-date and detailed information on pay levels in the adult care sector. The focus is on 'adult' care therefore we used only those records related to providers in the adult care sector. In addition, some duplication of records was evident and only one record for each worker has been used. Additionally, the data set contained individual workers' records with 'extreme' ages were excluded: as a first quality check step, we only included workers with ages in the range of 16 to 75 years.

To achieve the best possible accuracy in pay data, a number of additional measures were taken; further to selecting all unique individual workers' records, we only analysed pay data that had been updated during the past 12 months (prior to December 2009). Hourly rates were calculated for all workers whose employers provided information on their pay rates (whether hourly or annually) and their contracted hours, after a number of quality control steps. The first step was to eliminate extreme outliers, where outliers were calculated in relation to the median and quartiles of pay among different job roles in different regions (see Appendix A for details of outliers). This process ensured that workers with vey high earnings, such as executive directors and shareholders, are not included in the analyses to reduce bias. The process allowed for high or low figures proportionate to corresponding jobs and sector but excluded those with extremely high or low values subject to the distribution of pay among sub-groups of workers. Pay rates were all transformed and calculated on an hourly rate related to the exact contracted hours of workers, to enable comparison of workers performing different job roles and working with various work arrangement patterns. For the purpose of the mixed-effect models we included records with valid information on all variables used in the model. This process resulted in 88,982 adult care workers' records with valid and up-to-date pay and other necessary information for the analyses.

As illustrated in Equations 1 and 2, to account for factors beyond the scope of both the workers and the remit of NMDS-SC collection, we introduced three random levels (accounting for a total of four hierarchies). The random factors are related to individual providers who are nested within sectors, which in turn are nested within regions (individual workers can be regarded as being at the centre of this hierarchy). Additionally, the previous analyses showed that some measurable variables have an effect on pay levels (Hussein 2010). These can be viewed as 'fixed' effect variables. When modelling pay for each group of workers, we investigated the effect of each of the following macro and micro level factors: age of worker, gender, ethnicity, sector, type of service and their different interactions.

Workers' qualification levels can be assumed to have some effect on pay; however, due to the nature of NMDS-SC we were not able to include highest qualifications in the models for a number of reasons. The way that data on employees' highest qualifications is currently collected in the NMDS-SC means that the information is missing from a high proportion of records. NMDS-SC asks employers to indicate, for each worker, their highest-level qualification *which is relevant to social care*. Those who have no relevant qualifications are not distinguished from those with no qualifications or those whose employers do not

have information on their qualifications (true missing values).[3] In NMDS-SC Dec 2009, 54,623 records lacked information on highest level of qualifications out a total of 88,982 individual records with complete pay data. Also, as can be seen from Table 1, among those with information on qualifications, education levels are concentrated in one or two categories within each of the four job groups.

Furthermore, when examining median pay rates among the main job groups, the link between qualifications and pay rate is not straightforward. For example, median hourly rates for managers/supervisors without relevant qualifications is £12.40, a very similar figure to that recorded among those with level 4/4+ NVQ (£12.90); suggesting that excluding those with 'no relevant qualifications'[4] from the pay analysis may bias the findings.

Table 1 Distribution of each group of adult social care workers (among those with complete pay data) by highest qualification, NMDS-SC December 2009

Highest qualification	Direct care		Manager/ supervisor		Professional		Other	
	N	%	N	%	N	%	N	%
No relevant/ missing	40625	61.5	2195	37.9	2906	52.6	8897	76.6
Entry/1	181	0.3	2	0.0	9	0.2	75	0.6
Lev2/2+	14422	21.8	337	5.8	31	0.6	498	4.3
Lev3/3+	6354	9.6	1271	22.0	1955	35.4	220	1.9
Lev4/4+	1223	1.9	1718	29.7	529	9.6	206	1.8
Other relevant qualifications	3251	4.9	266	4.6	97	1.8	1714	14.8
Total	66056	100.0	5789	100.0	5527	100.0	11610	100.0

Bearing these data inadequacies in mind, it is evident that the inclusion of highest qualification level in any of our models would reduce our sample substantially and could result in inaccuracies in the findings. The instruction to record qualifications not perceived relevant to social care may result in inaccuracies when estimating the relationship between qualifications and pay. However, the mixed-effect models estimate the proportion of variance attributed to unmeasured variables on all levels, including those related to individual workers, which may include qualifications as well as other personal characteristics. Thus, four models are performed for the four job role groups; we included provider, sector and region as 'random' effects, and age, gender, ethnicity, sector, type of setting and all their interactions as fixed model. The variables are added using a forward step-wise process and the best model is selected for each group of workers.

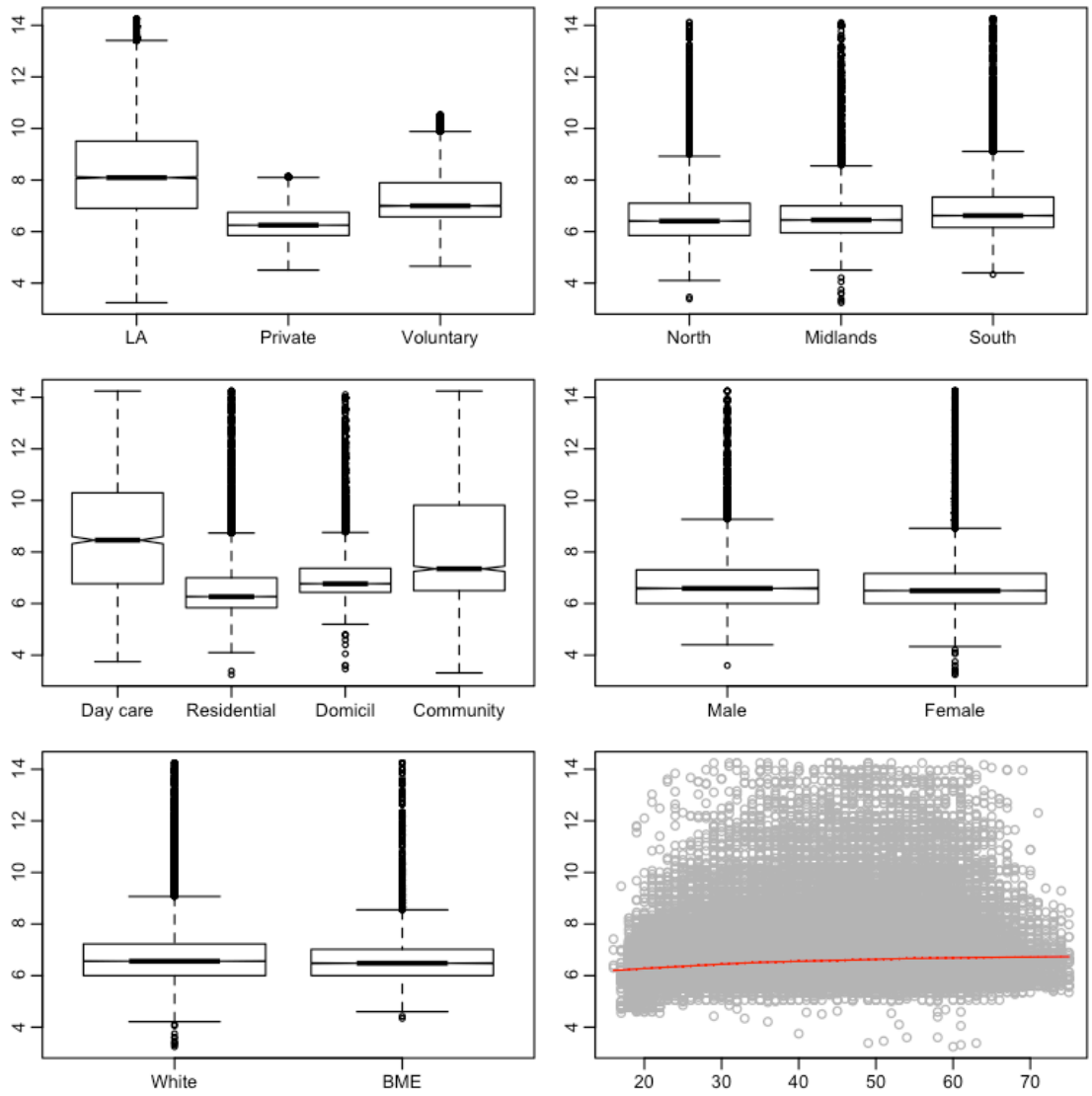
[3] Skills for Care is currently in the process of improving the questions related to highest qualification levels.
[4] 61.4% of all records with complete pay information

Modelling adult direct care pay

Direct care workers are a group of workers involved in providing direct care to people needing their support. They include people with job roles such as senior care worker, care worker, community support worker, employment support worker, advice and advocacy, educational support, technician, as well as other jobs directly involving care. A total of 66,056 direct care workers' records with valid information on hourly pay data, as well as the other variables included in the model, are used for this analysis. The median hourly pay rate for direct care workers is £6.47 (mean=6.76 and SD=1.23). However, as Figure 1 shows, their hourly pay rate varies considerably by different factors; particularly those on the macro level, such as sector and type of service.

For example, the hourly pay rate of direct care workers is highest among local authority or local authority-owned establishments, at a median of £8.09 (n=11,304); it is lowest for the private sector, where workers receive a median pay rate of £6.25 per hour (n=44,892). Similar variations can be seen in relation to the type of service in which workers are employed, with direct care workers in residential care receiving the lowest median pay, at £6.27 (n=20,015), in comparison to £8.46 among those working in day care (n=1,600). On the individual level, there are some slight variations by age, gender and ethnicity. For example, White direct care workers have a median hourly pay rate of £7.23 (n=54,119) compared to £7.02 (n=11,937) among workers from Black and minority ethnic (BME) groups. To examine the associations between all these variables and their interactions, and to take account of variations on a number of different levels, a mixed-effect regression analysis was used, as described in the 'Methods' section. To examine these relations we employed a forward stepwise process, starting with a simple model with only one variable while testing interactions as well as different level effects, namely region and employers. In the models we used age, centered around mean age of direct care workers (41.27 years), to examine the effect of deviating from the mean age on pay. The final model, presented in Table 1, is the one with optimal fit for the data (using the AIC and BIC as described in the methods section). Residual plots for this model are presented in Appendix B.

Figure 1 Variations in hourly pay of adult direct care workers by some selected individual and employer-level characteristics, NMDS-SC December 2009



As discussed in the Methods' section, due to the large variations observed between different sectors, we compared a number of different models, which included sector either as a random or a fixed effect, or on both levels. Using AIC and BIC criteria the latter model, which tests the effect of sector as both a random and fixed effect, was the best. Sector is therefore measured both as a hierarchy level and as a measurable fixed factor. The final mixed effect model, examining pay variations among direct care workers, contains three 'levels' of random effects. Random effects relate to the unmeasured effect of different providers (n=4420) nested within sectors (local authorities, private and voluntary), which in turn are nested within the three broad regions of England (North, Midlands and South). The model also tests the effect of 'fixed' factors related both to the individual workers and employers and to their interactions, as listed in the methods section. A summary of the final models, as well as significant results, is presented in Table 2.

Table 2 Results of final mixed-effect model of hourly pay of adult direct care workers, NMDS-SC December 2009

AIC	BIC	Log lik				
132220.3	132456.9	-66084.2				
Random effects						
	Standard Deviation	**Variance**	**Prop of variance**			
Groups						
Region	0.358	0.128	10.7			
Sector	0.231	0.053	4.4			
Provider	0.812	0.659	55.0			
Residual	0.599	0.359	29.9			
Number of cases				**N**		
Number of individual records				66,056		
Groups						
Region				3		
Sector within regions				9		
Providers within sectors within regions				4420		
Fixed Effects						
Variables	**Estimate**	**Std. Error**	**t-value (F-value)**	**p-value**	**Lower 95% CI**	**Upper 95% CI**
BME	-0.024	0.008	-2.99	0.003 **	-0.040	-0.008
Sector			(106.08)	<0.001 ***		
Private vs. LA	-3.008	0.302	-9.962	<0.001 ***	-3.846	-2.170
Voluntary vs. LA	-2.370	0.240	-9.866	0.001 ***	-3.037	-1.703
Service type			(143.01)	<0.001 ***		
Residential vs. day care	-1.085	0.098	-11.105	<0.001 ***	-1.277	-0.894
Domiciliary vs. day care	-1.081	0.113	-9.586	<0.001 ***	-1.303	-0.860
Community vs. day care	0.899	0.112	8.010	<0.001 ***	0.679	1.119
Age centered† & service type			(39.47)	<0.001 ***		
Age & residential	-0.001	0.001	-0.424	0.672	-0.003	0.002
Age & domiciliary	-0.005	0.001	-3.492	0.001 **	-0.008	-0.002
Age & community	-0.002	0.002	-0.915	0.360	-0.005	0.002
Service type & gender			(6.24)	<0.001 ***		
Day care & female	-0.177	0.040	-4.431	<0.001 ***	-0.256	-0.099
Residential & female	-0.008	0.009	-0.844	0.399	-0.026	0.011
Domiciliary & female	0.033	0.015	2.249	0.025 *	0.004	0.062
Community & female	-0.029	0.031	-0.940	0.347	-0.090	0.032
Sector & service type			(44.90)	<0.001 ***		
Private & Residential	0.808	0.242	3.346	0.001 **	0.335	1.282
Voluntary & Residential	1.157	0.161	7.178	<0.001 ***	0.841	1.473
Private & Domiciliary	1.161	0.251	4.632	<0.001 ***	0.669	1.652
Voluntary & Domiciliary	1.205	0.180	6.693	<0.001 ***	0.852	1.558
Private & community	-0.629	0.286	-2.198	0.028 *	-1.190	-0.068
Voluntary & community	-0.745	0.200	-3.732	<0.001 ***	-1.136	-0.353

* significant on 95% confidence level. ** significant on 99% confidence level. *** significant on 99.9% confidence level. † centered around mean age of direct care workers (41.27 years)

On the fixed level we included age, gender, ethnicity, type of service and sector as well as the interactions between all these factors. Both age and gender on their

own are not significantly associated with pay among direct care workers; however, some of their interactions are significant. As regards the measurable, fixed effect factors: ethnicity, sector and type of service all significantly affect direct care workers' hourly pay; with sector and type of service presenting the larger effect magnitude. Interactions between age, gender and type of service are also significant, albeit to a lesser degree.

The first main finding from this model is that 55 percent of variance in the hourly pay rate of direct care workers (total variance=1.199) relates to employers (or providers); followed by 11 percent determined by region of employment, and a further four percent relating to employment sector within a particular region. The residual 30 percent of the total variance in direct care workers' pay is understood to be attributed to unobserved individual variations not captured in the model.

Although sector has one of the most significant and numerically largest effects on pay, when measured as a fixed effect, the random variation related to sector *nested within region*, is less than half of the variation related to the random effect of region (4% vs. 11%). This suggests that although pay levels vary significantly between sectors across the country, variance related to sector is much less substantial after the pay effects of living in a particular region are accounted for.

The largest variance component in pay levels (55%) for direct care workers is attributed to individual providers nested within sector within regions, suggesting huge variations by service provider, even when these providers belong to the same sector and region. The size of variation attributed to individual providers (employers) is consistent with findings obtained from recent research in the United States (US) (Woodcock, 2008).

In terms of measurable variables included in the model, ethnicity, sector, type of service and interactions between age and sector, gender and type of services and sector with type of services all have a significant effect on the pay levels of adult direct care workers. The variable with the numerically largest effect is sector, where direct care workers in the private and voluntary sectors earn considerably less than their counterparts in local authorities (ß= -3.008, -2.37; $p<0.001$ and $p=0.001$ respectively). The next most significant variable was type of service, where those working in adult community care services reported the highest wages, followed by those in day care services, while workers in both residential and domiciliary services earned significantly less. For example, those working in either residential care (or domiciliary care) are estimated to earn £1.09 (or £1.08) per hour less than those working in day care services ($p<0.001$ for both estimates). The model also identifies some significant interactions between sector and service type.

In terms of personal characteristics, only ethnicity, in itself, is significantly associated with pay among direct care workers. Workers who were identified by their employers as belonging to Black or minority ethnic groups (BME) had a significantly lower hourly pay rate. However, the magnitude of the difference is not large (ß=-0.024, $p=0.003$).

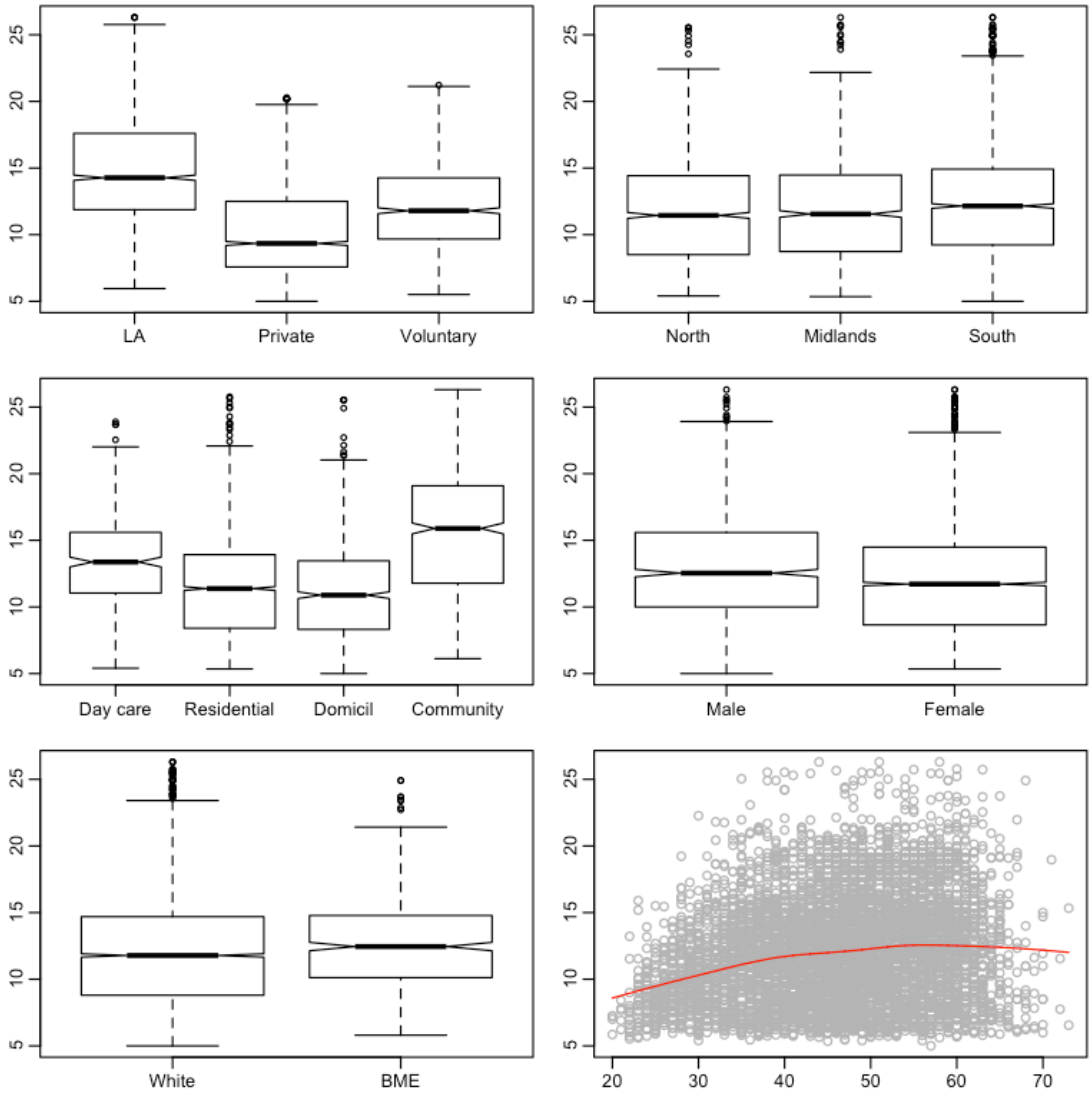
Age (centered around mean age) and gender are not significantly associated with hourly pay rate on their own account; however, looked at in the context of particular service types, some significant interactions can be seen. For direct care workers in domiciliary settings, each additional year above the average age significantly lowered their hourly pay, compared to workers of similar age in day care settings (ß=-0.005, p=0.001). However, within domiciliary services, women earn slightly more than men, although this difference is of a lower order of significance (ß= 0.033, p=0.024).

Modelling adult care managers/supervisors' pay

Managers/supervisors form a group of job roles that includes senior management, middle management, first line managers, registered managers, supervisors, and other managers in care-related jobs. We were able to identify 5,789 records for managers/supervisors working in adult care, with complete information on pay and other characteristics. The median hourly pay rate for this group is £11.63 per hour; within this, pay is highest among the subgroup of registered (under the Care Standards Act 2000) managers at £13.35 (n=1326) and lowest among supervisors at £9.55 (n=1437). The median hourly pay rate for managers/supervisors varies considerably by subgroup. Figure 2 shows that managers'/supervisors' median hourly rate of pay is lowest in the private sector, at £9.34 (n=2615), and amongst women, overall at £11.72 (n=4808).

As illustrated in Figure 2, the median hourly pay rate for adult care managers/supervisors is highest for workers employed by local authorities, for those in the South of England, for workers in community care services and for men. There is also a positive trend between age and hourly pay rate of managers/supervisors. Hourly pay rate is slightly higher among managers/supervisors from BME groups; however, the difference is not significant as visualized by Tukey's notches (Tukey 1977).

Figure 2 Distribution of hourly pay rate of manager/supervisors by different micro and macro factors, NMDS-SC December 2009



Similar step-wise mixed effect models were constructed to examine the association between different variables and pay among managers/supervisors, while accounting for unmeasured factors on different levels. Age is centered around the mean age of managers/supervisors (48.26 years). As was the case with the previous model, the effect of sector on the variation in pay was included as both a random and a fixed effect. Table 3 presents the findings of the final mixed-effect model of managers'/supervisors' hourly pay rate. The model contains four hierarchical levels; the individual nested within provider within sector, which in turn is nested within region. A summary of residual plots is presented in Appendix C.

Unlike results for the previous model, direct care workers, nearly three quarters (73%) of the variance in managers'/supervisors' pay rates (total variance= 11.074) can be attributed to unmeasured factors and only 22.4 percent to variations between employers within sectors. Region accounts for less than four

percent of the total variance and sector only one percent. These results are not particularly surprising, for a number of reasons. First, roles within this group of workers are quite diverse, as reflected in the differing median hourly pay rates for individual job roles (presented in Issue 6). For example, the median hourly pay rates for supervisors and for managers in non-care providing roles are £9.55 and £9.84 respectively, while pay for registered managers reaches on average £13.46 an hour. Secondly, many personal and managerial skills, which are likely to influence the pay rate of workers in this group, are not measurable within the NMDS-SC. Different levels of training, management-specific qualifications, and degree of experience are not examined separately in the model and are likely to contribute to the 73 percent of pay rate variance attributed to unmeasured factors.

Nevertheless, 22 percent of pay variation among managers/supervisors are attributed to providers, after accounting for both region and sector. As with the findings related to direct care workers, the measurable effect of sector on manager/supervisor pay rates is both significant and large in magnitude. For example, those working in the private sector are estimated to earn £4 per hour less than those working for local authorities (ß= -3.821, $p<0.001$).

Service type is also significantly associated with pay levels amongst the managerial/supervisory group. Those working in domiciliary care earn the least, and those in community care the most, when compared to managers/supervisors in local authorities (ß= -0.519 and 2.095; $p=0.046$ and $p<0.001$ respectively).

Table 3 Results of final mixed-effect model of hourly pay of manager/supervisors in the adult care sector in England, NMDS-SC December 2009

AIC	BIC	Log likelihood				
29838.7	29938.7	-14904.4				
Random effects						
	S.D.	**Variance**	**Prop of variance**			
Groups						
Region	0.631	0.398	3.6			
Sector	0.308	0.095	0.9			
Provider	1.575	2.481	22.4			
Residual	2.846	8.100	73.1			
Number of cases				**N**		
Number of individual records				5789		
Groups						
Region				3		
Sector within regions				9		
Providers within sectors within regions				2712		
Fixed Effects						
Variables	**Estimate**	**Std. Error**	**t-value (F-value)**	**p-value**	**Lower 95% CI**	**Upper 95% CI**
Women vs. men	-0.469	0.111	-4.219	<0.001 ***	-0.687	-0.469
Sector			(80.05)	<0.001 ***		
Private vs. LA	-3.821	0.289	-13.239	<0.001 ***	-4.622	-3.821
Voluntary vs. LA	-2.351	0.304	-7.744	0.002 **	-3.194	-2.351
Service type			(87.90)	<0.001 ***		
Residential vs. day care	0.112	0.238	0.471	0.638	-0.355	0.112
Domiciliary vs. day care	-0.519	0.260	-1.999	0.046 *	-1.028	-0.519
Community vs. day care	2.095	0.267	7.854	<0.001 ***	1.572	2.095
Age centered† & service type			(12.08)	<0.001 ***		
Age & residential	0.019	0.018	1.079	0.281	-0.016	0.019
Age & domiciliary	0.009	0.019	0.449	0.653	-0.029	0.009
Age & community	0.090	0.021	4.358	<0.001 ***	0.050	0.090

* significant on 95% confidence level. ** significant on 99% confidence level. *** significant on 99.9% confidence level. † centered around mean age of manager/supervisors (48.26 years)

On the personal level, gender is associated with pay among managers/supervisors. After controlling for other factors, women earn significantly less than men (ß= -0.469, p<0.001). While age in itself is not significantly associated with pay rates, its interaction with service type is. The results show that for each year managers/supervisors in community care are above the median age (48 years) they earn slightly, but significantly, more per hour (ß= 0.09, p<0.001).

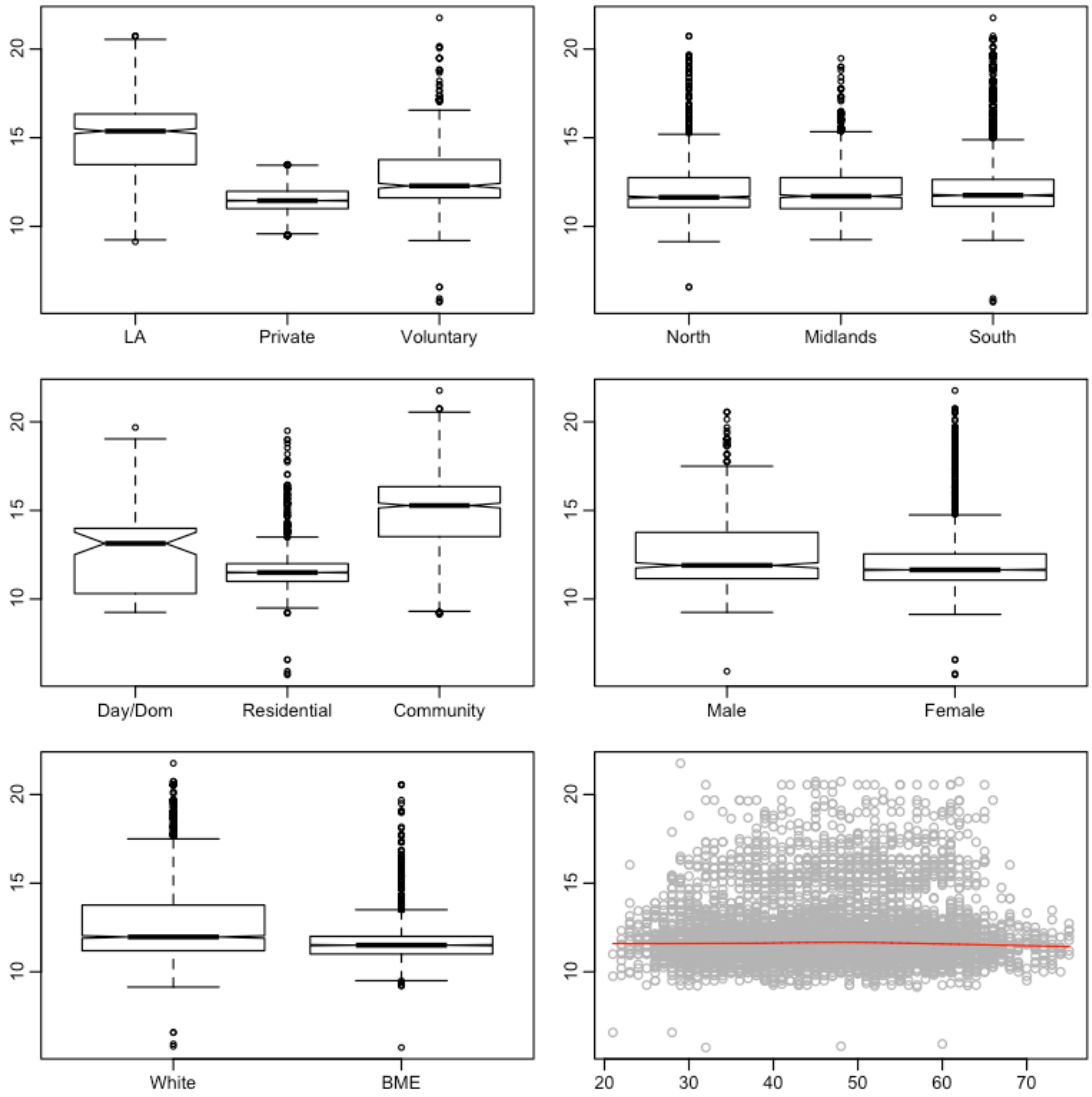
Modelling adult care professionals' pay

Professionals in adult care include social workers, occupational therapists, registered nurses and allied health professionals. They, as a group, have one of the highest median hourly pay rates, at £11.57, which is very similar to that among managers and supervisors (£11.63). Within this group social workers and occupational therapists have the highest median hourly pay rates, at £15.40 and £15.08 (n=924 and 212) respectively. Allied health professionals receive a median hourly rate of £13.46 (n=48) while registered nurses earn on average £11.50 per hour (n=6,727). Out of the total 7,913 records with complete pay data, 5,527 had valid information related to all variables under examination in the current models. The median age for professionals employed in adult care is 46.15 years and this median is used as the age centre in the mixed-effect model examining professionals' pay rate.

Figure 3 visualises some of the variations observed in professionals' pay rate distributions by a number of micro and macro variables, using box-plots and scatter plots with a fitted line of association for age. As with direct care workers and managers/supervisors in adult care, on a one-level analysis, large variations are observed in relation to both sector and type of service.[5] In terms of employment sector, the median hourly pay rate for adult care professional staff is considerably higher among those working in local authorities, at £16.34 (n=1,047), and lowest among those working in the private sector, at £11.98 (n=3,906). However, the distribution of professional staff's pay is considerably wider in local authorities than in the private sector, where most individual hourly pay rates appear to be concentrated around the median. In terms of type of services, those working in community care receive the highest median hourly rate, of £15.28 (n=4,382), while those working in residential care earned the lowest median pay rate of £11.50 (n=4,382). We also note that the distribution of hourly pay rate is much narrower among professionals working in residential care settings in comparison to those working in community care settings.

[5] Note that only 4 professionals working in domiciliary settings have complete pay information as well as valid data for all other variables (age, gender, ethnicity, type of service, sector and region). These are added to day care professional staff in the following analysis.

Figure 3 Distribution of adult care professionals' hourly pay rate by different micro and macro factors, NMDS-SC December 2009



On the personal level, both gender and ethnicity appear to have some association with pay among professionals; however, no clear relationship can be deduced in relation to age. For both women, and those from BME communities, median hourly rates are lower than their counterparts. However, there appears to be less variation in pay amongst these groups, with the 3rd quartile of pay much lower than for men and White professional staff (£14.75 vs. £17.49 and £13.50 vs. £17.50 respectively).

As with the previous two groups of workers, we employed linear mixed-effect models to estimate levels of association between observed, and non-observed, factors affecting pay rates among adult care professional staff. Table 4 presents the findings of the final mixed-effect model, which contains four hierarchical levels; that of the individual nested within provider within sector, which in turn is nested within region. Residual plots of the final model are presented in Appendix D.

Just over half of the variance in professionals' pay rates is attributed to factors not accounted for in the model (mainly on the individual level). A substantial part of the variance (36%; total variance= 2.058) is attributed to variation in pay across different providers (or employers). Region accounts for 6 percent of professional pay variance; and sector, after accounting for region, may explain 4 percent of pay variance not due to measured variables in the model.

Among all variables measured in the model as having 'fixed' effects, all personal characteristics are significantly associated with professional pay rates, as are sector of employment and the interaction between sector and age. The model confirms that professional workers from BME communities, as well as women, earn significantly less than white workers and men after accounting for all other factors (ß= -0.104 and -0.123; p= 0.005 and 0.007 respectively). However, variations related to ethnicity are likely to be attributed to the concentration of 'Asian' and other BME workers within nurses (working in adult care not in the NHS), who earn on average lower than other professionals such as social workers and occupational therapists. For example, 53 percent of registered nurses belong to BME groups compared to 15 percent among social workers and only 7 percent among occupational therapists.

For professional staff, age is significantly associated with pay; every additional year than the mean age (46.15 years) is estimated to add £0.054 to hourly pay ($p<0.001$). However, a negative interaction was found between age and sector, meaning that older professional staff in both the voluntary and private sectors see a smaller pay decrease than their counterparts in local authorities (ß= -0.027 and -0.021; $p<0.001$ respectively).

Table 4 Results of final mixed-effect model of hourly pay of adult care professional staff in England, NMDS-SC December 2009

AIC	BIC	Log likelihood				
17684.8	17764.2	-8830.4				
Random effects						
	S.D.	**Variance**	**Prop of variance**			
Groups						
Region	0.346	0.120	5.8			
Sector	0.275	0.076	3.7			
Provider	0.862	0.743	36.1			
Residual	1.058	1.119	54.4			
Number of cases				**N**		
Number of individual records				5527		
Groups						
Region				3		
Sector within regions				9		
Providers within sectors within regions				917		
Fixed Effects						
Variables	**Estimate**	**Std. Error**	**t-value (F-value)**	**p-value**	**Lower 95% CI**	**Upper 95% CI**
Age (centered)	0.054	0.003	15.3	<0.001 ***	0.047	0.060
Women vs. men	-0.123	0.046	-2.700	0.007 *	-0.212	0.034
BME vs. white	-0.104	0.037	-2.811	0.005 **	-0.176	-0.031
Sector			(110.8)	<0.001 ***		
Private vs. LA	-3.512	0.243	-14.440	<0.001 ***	-4.187	-2.836
Voluntary vs. LA	-2.798	0.273	-10.241	0.001 **	-3.56	-2.039
Age centered† & sector			(92.5)	<0.001 ***		
Age & private	-0.051	0.004	-13.246	<0.001 ***	-0.059	-0.044
Age & voluntary	-0.027	0.006	-4.733	<0.001 ***	-0.038	-0.016

* significant on 95% confidence level. ** significant on 99% confidence level. *** significant on 99.9% confidence level. † Centered around age of professional workers (46.15 years)

The most pronounced measured effect in professional pay is attributed to sector, which is similar to findings relating to direct care workers and manager/supervisor roles. However, the type of service was not significantly associated with professional pay after accounting for other random and fixed effects in the model. Professionals working in the private sector are estimated to earn £3.512 per hour less than those working in local authorities, while those working in the voluntary sector are estimated to earn £2.798 per hour less than the same reference group ($p<0.001$ and 0.001 respectively).

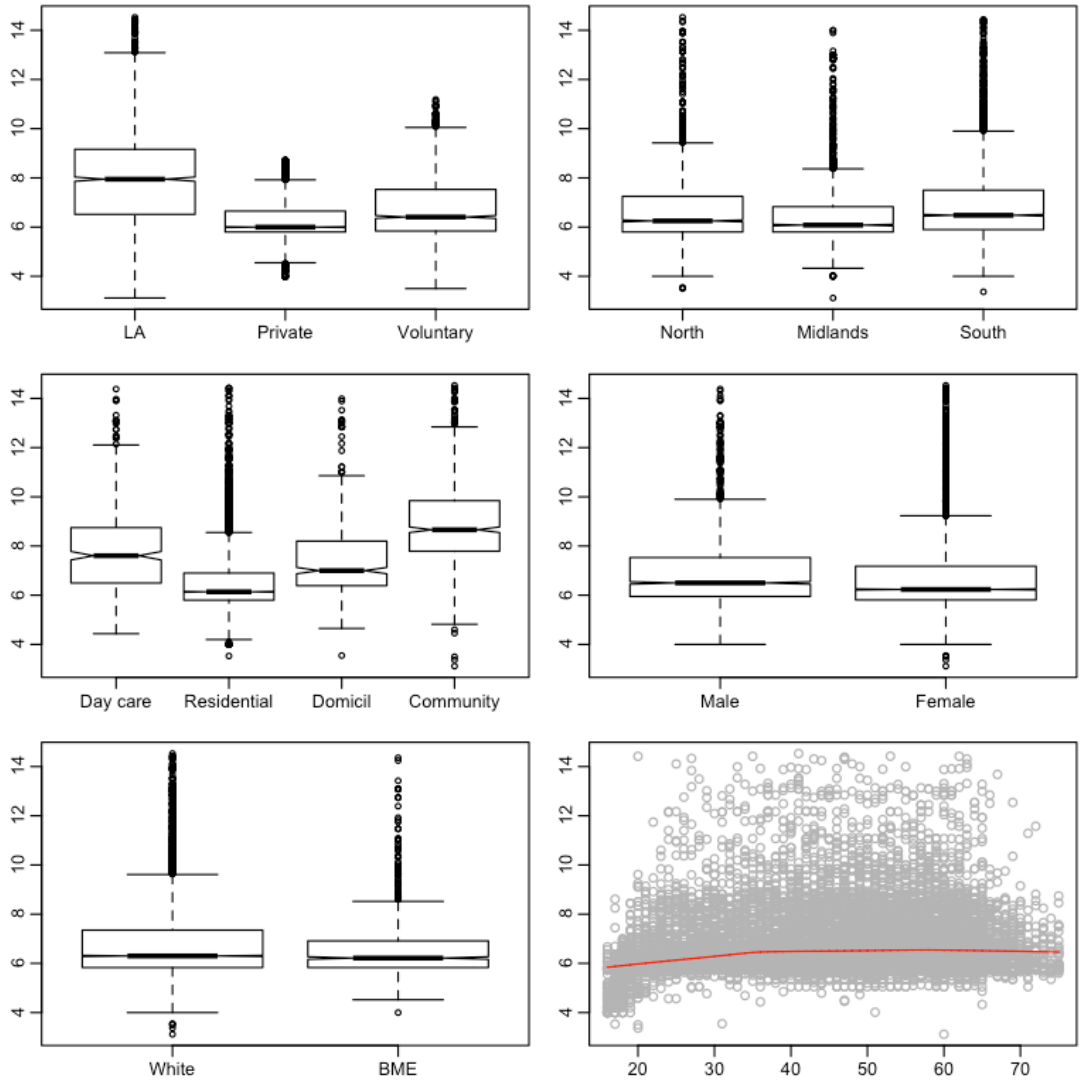
Modelling pay for 'other' job roles in adult care

A number of 'other' job roles exist in the adult care sector. These include administrative staff, ancillary staff and other job roles not directly involving care. The median hourly pay rate of staff with 'other' job roles is very close to that observed for direct care workers, at £6.23 (compared to £6.24). On average, administrative staff earn the most (at £7.93), followed by non-care providing staff at £6.34 and then by ancillary staff, who are the lowest-paid at £6.00 per hour. For the current analysis we identify 11,610 workers with 'other' job roles who have complete pay and other relevant information.

Figure 4 presents box-plots of the distribution of hourly pay rate of adult care workers with 'other' job roles by sector, type of service, region, gender and ethnicity. A scatter plot of age and hourly pay rate among this group is also presented. As Figure 4 shows, the hourly pay rate for 'other' job roles is highest in local authorities, the South region and in community care settings. The median hourly rate for 'other' jobs is slightly higher for men than women (£6.50 vs. £6.23) and for white workers than those identified to belong to BME communities (£6.30 vs. £6.21). As with observations in relation to the previous three job groups, pay distribution seems to be widest among local authorities and narrowest among workers in the private sector and those working in residential care. Pay distribution is also relatively narrow among women and BME staff when compared to that observed for men and white workers.

To examine these associations together and to identify the contribution of non-observed factors on different levels of nesting in relation to pay, step-wise linear mixed-effect models were undertaken for this group, similar to those created for the previous three groups of workers. The 'random' effect was measured for the nested structure of providers within sectors within region. Fixed effects included in the model are: age (centered around the mean of 45.55 years), gender, ethnicity, sector, type of service and their interactions. Table 5 presents a summary of the final model as well as findings related to significantly associated variables. Residual plots of the final model are presented in Appendix E.

Figure 4 Distribution of hourly pay rate among adult care workers with 'other' job roles by different micro and macro factors, NMDS-SC December 2009



The results of the linear mixed-effect model presented in Table 5 show that, 31 percent of pay variance (total variance= 1.462) among adult care workers with 'other' job roles can be attributed to providers, while equal proportions of six percent are explained by different sectors within regions and by regional variations. The remaining 57 percent of pay variance must be attributed to unobserved factors, which do not relate to region, sector or provider and may be attributed to personal experience or characteristics.

Of the measured estimated effects, sector has the largest association with pay rates of 'other' adult care workers; but this association has a smaller magnitude and is of a lower order of significance than that observed among the previous three groups of workers. Adult care workers performing 'other' jobs earn an estimated £1.487 less per hour if they are working in the private sector and £1.140 less if working in the voluntary sector, when compared to those working in local authorities (p=0.004 and 0.011 respectively). Type of service or

provision is also significantly associated with pay levels for 'other' jobs in adult care, where those working in residential care earn the least and those employed in community care the most (ß= -0.641 and 0.945; p<0.001 respectively).

Table 5 Results of final mixed-effect model of hourly pay of 'other' job roles in the adult care sector in England, NMDS-SC December 2009

AIC	**BIC**	**Log likelihood**				
33454.8	33557.8	-16713.4				
Random effects						
	S.D.	**Variance**	**Prop of variance**			
Groups						
Region	0.298	0.089	6.1			
Sector	0.304	0.092	6.3			
Provider	0.670	0.449	30.7			
Residual	0.912	0.832	56.9			
Number of cases				**N**		
Number of individual records				11610		
Groups						
Region				3		
Sector within regions				9		
Providers within sectors within regions				2390		
Fixed Effects						
Variables	**Estimate**	**Std. Error**	**t-value (F-value)**	**p-value**	**Lower 95% CI**	**Upper 95% CI**
Sector			(18.64)	<0.001 ***		
Private vs. LA	-1.487	0.254	-5.858	0.004 **	-2.191	-0.782
Voluntary vs. LA	-1.140	0.257	-4.435	0.011 *	-1.853	-0.426
Service type			(175.29)	<0.001 ***		
Residential vs. day care	-0.641	0.094	-6.800	<0.001 ***	-0.825	-0.456
Domiciliary vs. day care	0.272	0.113	2.399	0.017 *	0.050	0.494
Community vs. day care	0.945	0.110	8.603	<0.001 ***	0.730	1.160
Age centered† & service type			(8.12)	<0.001 ***		
Age & residential	0.020	0.005	4.353	<0.001 ***	0.011	0.029
Age & domiciliary	0.019	0.006	3.212	0.001 **	0.007	0.030
Age & community	0.026	0.005	4.899	<0.001 ***	0.016	0.037

* significant on 95% confidence level. ** significant on 99% confidence level. *** significant on 99.9% confidence level. † centered around mean age of workers with 'other job roles (45.55 years)

None of the personal characteristics included in the model is associated with pay among adult care workers with 'other' job roles. However, the interaction of age with service type was significantly associated with pay. The latter identifies a positive relationship between older than average age, and pay, in all service types when compared to that observed in day care settings.

Summary and Discussion

NMDS-SC provided a much-needed opportunity to investigate pay levels and variations in relation to different job roles in the adult social care sector in England. The structure of the NMDS-SC is ideally suited for the examination of matched employee-employer data on pay, since data records on individual workers are linked directly to employers (providers) and their own set of characteristics. The current analyses further employed hierarchical modelling, using linear mixed-effect models, to account for the nested effect of different factors on pay. Mixed-effect models correct bias in the estimated coefficients due to omitted person, provider, and/or match effects. In addition to examining the level of association between measured characteristics and pay, mixed-effect models also estimate the proportion of pay variation that can be attributed to unobserved characteristics (those not measured in the data being used) at each hierarchical level. Thus, we were able to estimate the effect of region, sector and provider on individual workers' pay. Performing separate models for the four main groups of workers reduced the level of noise related to the large pay-gap observed between different groups of workers, as discussed in Issue 6. The models also estimate more accurate (not inflated) pay variations related to observed characteristics such as gender, age and ethnicity. They thus provide insight into the main associations between and significance of a number of factors, at a series of hierarchical levels, for each group of workers; namely direct care workers, managers/supervisors, professionals and those with 'other' (non-care providing) job roles.

The findings of the four models indicate that the relative influence on pay of different hierarchical levels (provider, sector and region) differs for each group of workers. Table 6 summarises the estimated proportion of pay rate variance attributed to 'random' effects, or levels of hierarchies, included in the four mixed-effect models. Managers/supervisors have the highest variance at 11.074, which is much higher than that observed for each of the other three job groups (2.058 among professionals, 1.462 among other workers and 1.199 among direct care workers). The later indicating considerable variations in hourly pay rate of managers/supervisors, these can not be attributed to neither the fixed or the random parts of the models. The findings show that pay variation attributed to regional effects is highest among direct care workers, at 10.7 percent, followed by 'other' job roles, at 6.1 percent of the variance. Pay-variance attributed to regional effects was considerably higher than that attributed to sector for all job roles except 'other' jobs, where both region and sector exercised an almost identical effect (6.1% and 6.3%).

Pay variance attributed to provider, however, varied considerably across different job groups. Slightly over half (55%) of pay variance among direct care workers is estimated to derive from the provider by whom workers are employed, compared to less than a quarter (22.4%) of pay-variance among the managers/supervisors group. Furthermore, nearly three quarters (73.1%) of pay

variance among managers and supervisors is estimated to derive from unobserved personal or other characteristics not included in the model. The latter strongly suggests the extent to which the large variations in pay levels among this group can be attributed to personal skills and qualifications.

Table 6 Proportion of variance attributed to different 'random' effects on pay rates for each of the four main job role groups as identified by mixed-effect models

Proportion of variance	Direct care	Manager/ supervisor	Professional	Other job roles
Region	10.7	3.6	5.8	6.1
Sector	4.4	0.9	3.7	6.3
Provider	55.0	22.4	36.1	30.7
Residual	29.9	73.1	54.4	56.9

For professional staff and 'other' job roles, nearly a third of variance is attributed to providers (36.1% and 30.7% respectively), while that due to unmeasured effects stands at over fifty percent.

In terms of estimated associations between measured characteristics and pay levels, Table 7 provides a summary of significant relationships for different job groups, with the direction of the relation identified.

Table 7 Summary of associations between 'fixed' effects and pay level for different job groups

Fixed effects	Direct care	Manager/ supervisor	Professional	Other job roles
Age (older than mean)	NS	NS	+ve ***	NS
Women	NS	-ve ***	-ve *	NS
BME	-ve **	NS	-ve **	NS
Sector				
Private vs. LA	-ve ***	-ve ***	-ve ***	-ve **
Voluntary vs. LA	-ve ***	-ve **	-ve **	-ve *
Type of service				
Residential vs. day care	-ve ***	NS	NS	-ve ***
Domiciliary vs. day care	-ve ***	-ve *	NS	+ve *
Community vs. day care	+ve ***	+ve ***	NS	+ve ***

On the personal level, age was significantly associated with pay levels only among professional workers in adult social care. Being older than average had a significantly positive relationship with pay among this group in other words, older workers tended to be paid more. Some interactions with age were also significant. Direct care workers in domiciliary care settings who are older than average (41.2 years) are particularly prone to low pay. While on the other hand, managers and supervisors working in adult community care settings who are older than average (48.3 years) are likely to earn significantly more than those

below the average age. There are similar positive associations between age (older than 45.5 years) and employment in adult community, residential and domiciliary settings. While professional workers, although in general older than average workers (46.1 years) earn more than younger workers, those working in either the private or voluntary sectors earn significantly less than their younger counterparts.

Gender was estimated to have a significant association with pay level for both managers/supervisor and professional workers, the two groups with the highest median pay rates. Women in both these job groups earn significantly less than men; however, the level of significance is lower for professional staff than for managers. The interaction between gender and type of service significantly affects direct care pay rates. Women direct care workers earn significantly less than men, particularly in adult day care settings; however, they earned more (albeit with a lower significance level of $p= 0.025$) than men in domiciliary care settings. Ethnicity is significantly associated with pay levels for direct care workers and professional workers, with workers from BME groups earning significantly less after all other variables have been accounted for. However, ethnic pay-gap among professional staff is almost entirely attributed to the high proportion of nurses who are from BME communities – mainly working in the care home sector - relative to that among social workers and occupational therapists (mainly working for local authorities), and nurses earn on average much less than the latter two groups. No direct explanation can be deducted from the data in relation to the ethnic pay-gap observed for direct care workers, which is consistent with findings related to prevalence of national minimum wage for low paid jobs (Low Pay Commission 2009).

On the measured macro level variables, sector has the highest and numerically largest association with pay rates for all job roles. Estimated pay rates are significantly lower among the private sector than amongst local authorities. Pay rates in the voluntary sector are also significantly lower than in local authorities, particularly for direct care workers. For professionals and managers/supervisors these differences are also significant, but a lower significance level of $p<0.005$; and $p<0.05$ among workers with 'other' job roles.

The type of service provided emerged as also significantly associated with pay rates, particularly for direct care and 'other' job roles. Those working in adult community care settings earn significantly more, followed by adult day care workers, while direct care workers in residential or domiciliary care settings earn significantly less. Type of service, however, is not significantly associated with pay rates among professionals. The interactions of sector and type of service are significant for direct care workers. Voluntary residential and domiciliary settings paid significantly to direct care workers than other voluntary settings, while voluntary community settings paid them significantly less.

The analyses highlight the important variations in pay in relation to both sector and type of setting, but also emphasise the role played by individual providers, particularly for direct care workers. Between 22 percent and 55 percent of pay

variance among the main four groups of workers can be attributed to the effect of individual employers, while accounting for both sector and region.

The current analyses provide, for the first time, what is almost a complete picture of the levels of pay in the care sector and the factors influencing them, separated for different job role groups. Public-private, as well as voluntary, pay-variations are considerable within the care sector. Such findings are consistent with research in other sectors in more economically developed countries (MEDC) (for example Lucifora and Meurs 2004, Melly 2005). Pay in the care sector demonstrates the expected relationship between skill-level and sector pay. Although those in low-skilled jobs working in the public sector earn significantly more than their counterparts in the private and voluntary sectors, the difference is narrower for those in high-skilled job roles. This consistent with what Lucifora and Meurs (2004) showed in Great Britain, where pay in the private sector only exceeds that of the public sector for very highly-skilled professions. The magnitude of the difference between local authority and private pay was considerably large among all jobs involving care (β= -3.008 for direct care, β= -3.821 for manager/supervisors and β= -3.512 for professionals) but lower among 'other' non-care providing jobs (β= -1.487). However, given that the share of independent sector (private and independent) provision in the adult care sector is considerable, at around 70 percent (Eborall and Griffiths 2008), a relatively small proportion of workers benefit from the better pay levels observed for local authority workers.

The majority of adult domiciliary and residential care is provided by the private sector, while both community care and adult day care settings are dominated by local authority provision (Eborall and Griffiths 2008). Thus, the findings showing that workers, particularly direct care workers, employed in the former two settings earn significantly less than those in the latter two settings are not surprising. The interaction between sector and type of service was particularly significant for direct care workers, who are already at the lower end of pay levels within the care sector.

Gender pay-gaps are a particular concern as they are only significant at the high end of pay scales within the sector (namely among professional staff and those with managerial/supervisory roles) although the magnitude is much lower than that related to sector (β= -0.123, p= 0.007 and β= -0.469, p<0.001 respectively). It is interesting to note that relatively large proportions of managers/supervisors and 'other' workers are men (19.7% and 21.5%) in comparison to direct care workers and professional workers (14.2% and 13.2%) (Hussein 2009). However gender pay-gaps are present within groups of workers with higher median pay rates rather than those with higher proportions of men. These differences are significant while accounting for other factors including ethnicity, indicating that this pay gap affects White men and women as well as BME men and women.

There are a number of factors that might explain these variations, including the distribution of women's specific positions within manager/supervisor and professional groups. Work patterns and leave periods may be different for men and women within these job groups, due to culturally dictated roles; women's

tendency to engage in caring roles outside of work can also play a part in their access to training and promotions, which in turn will influence pay levels. However, contrary to suggestions by some researchers that the gender wage-gap is larger within predominantly female jobs (Olivetti and Petronogolo 2006), the gender pay-gap was not significant among direct care workers, where over 80 percent of employees are women. The gender pay-gap in the care sector seems to be significant within higher paid jobs rather than lower paid jobs.

Ethnicity, on the other hand, significantly affected pay rates for both professional workers (with median pay rate of £11.57 per hour) and direct care workers (median pay rate of £6.47 per hour), thus operating at both ends of the pay scale in the care sector. The ethnicity pay-gap for direct care workers echoes findings from the Low Pay Commission (2009), stating that BME workers are more likely to receive the national minimum wage than their White counterparts particularly in low-paid jobs. For professional jobs, this is associated with the internal profile of direct care workers and professional workers in the adult care sector, where workers from BME communities are relatively over-represented in comparison to managerial/supervisory and 'other' roles (Hussein 2009). For example, the relative concentration of BME workers in professional jobs is mainly attributed to their high proportion within the nursing profession (in care homes) rather than other roles such as social work and occupational therapy, and the median hourly pay rate for nurses is considerably lower than that among the latter two job roles (£11.50 vs. £15.40 and £15.08 respectively).

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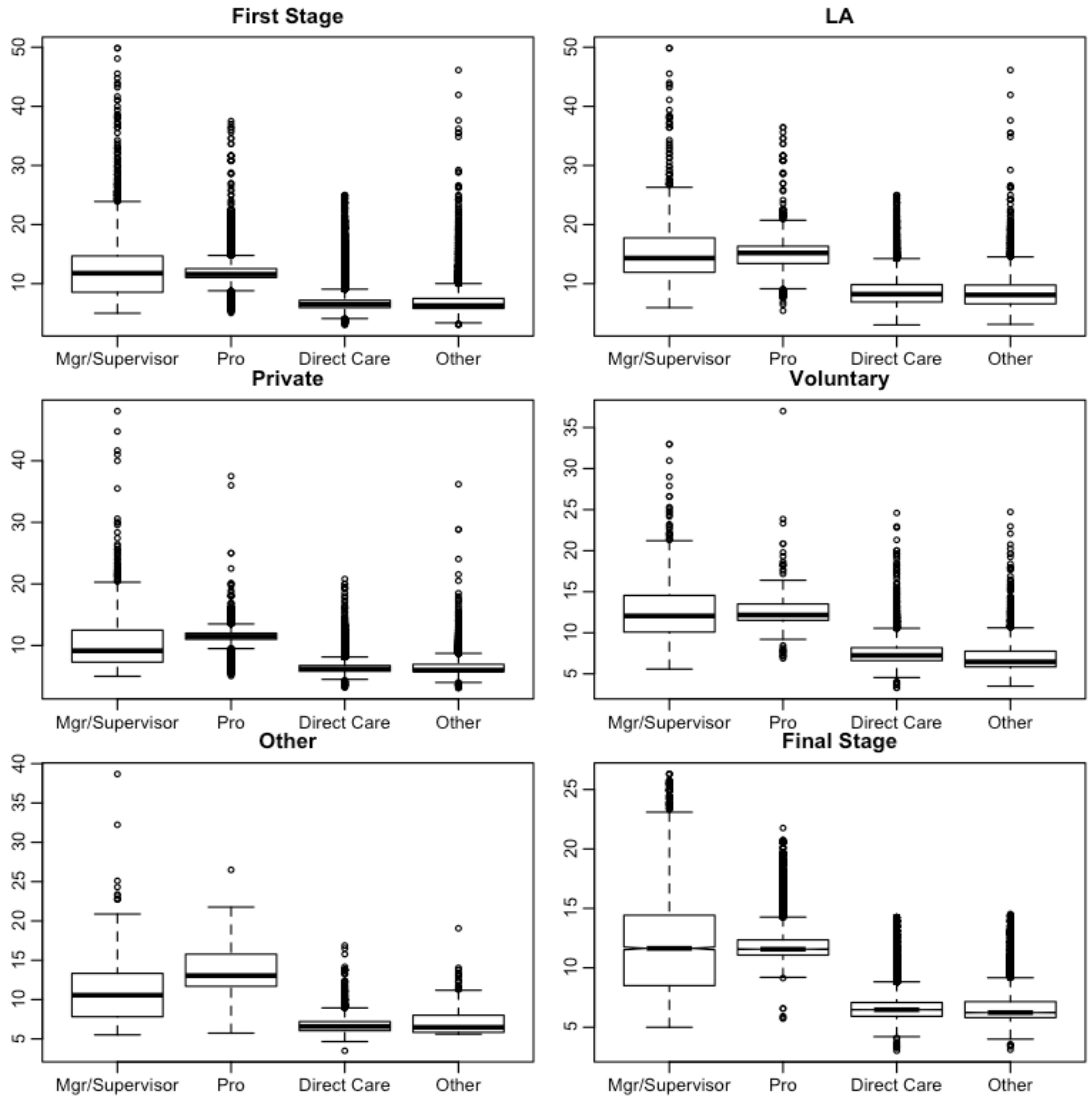
Appendix A

Selecting records and removing outliers

After selecting records related to adult care and removing duplicates; only those with complete and updated pay data were included. All pay rates were transformed to hourly pay using a number of variables including work patterns and contracted hours. However, pay information included unrealistic figures, in both extreme ends, the first stage of the cleaning process involved removing those with obvious extreme figures using boundaries provided by Skills for Care among different job role groups. The distribution of hourly pay rates by different job role groups can be seen at the top left corner of Figure 5.

Figure 5 Visualisation of stages of outliers' exclusions by different job role groups and within each sector in a progressive forward step process



Further progressive steps of outliers' exclusion were applied for each of the job groups within each of the four main sectors. Hourly pay rates were distributed then using a calculation based on lower and upper quartiles as well as inter-quartile range. Moving from the top left hand corner of Figure 5 to the bottom right hand corner we can see the elimination process for pay distribution within each job role group.

Appendix B

Residuals plots of the final mixed-effect model of direct care workers' pay

Figure 6 Final mixed-effect model of hourly pay rate for direct care workers: distribution of residuals, centered around 0, by region (first random effect)

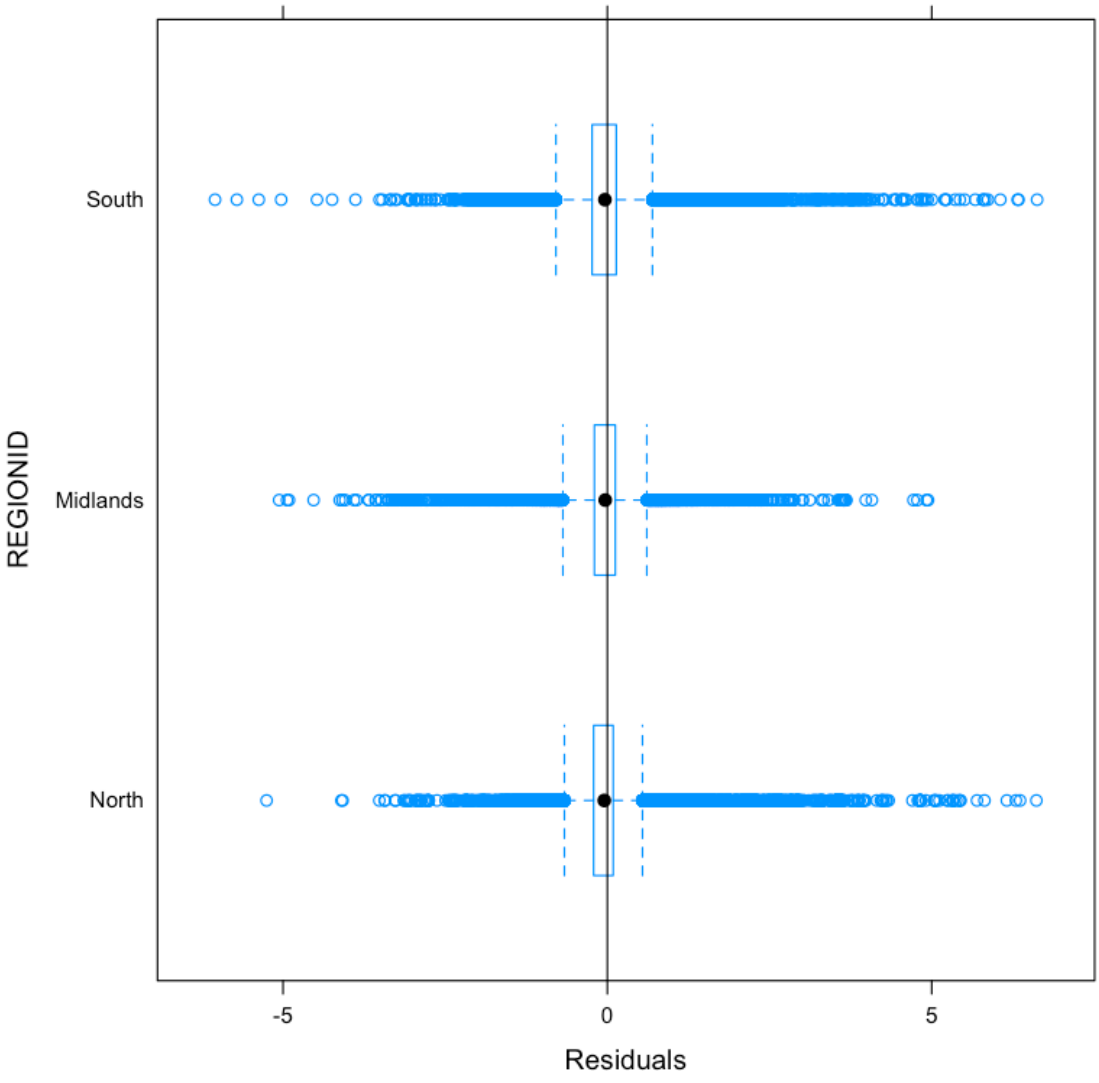


Figure 7 Final mixed-effect model of hourly pay rate for direct care workers: distribution of residuals, centered around 0, by sector (second random effect)

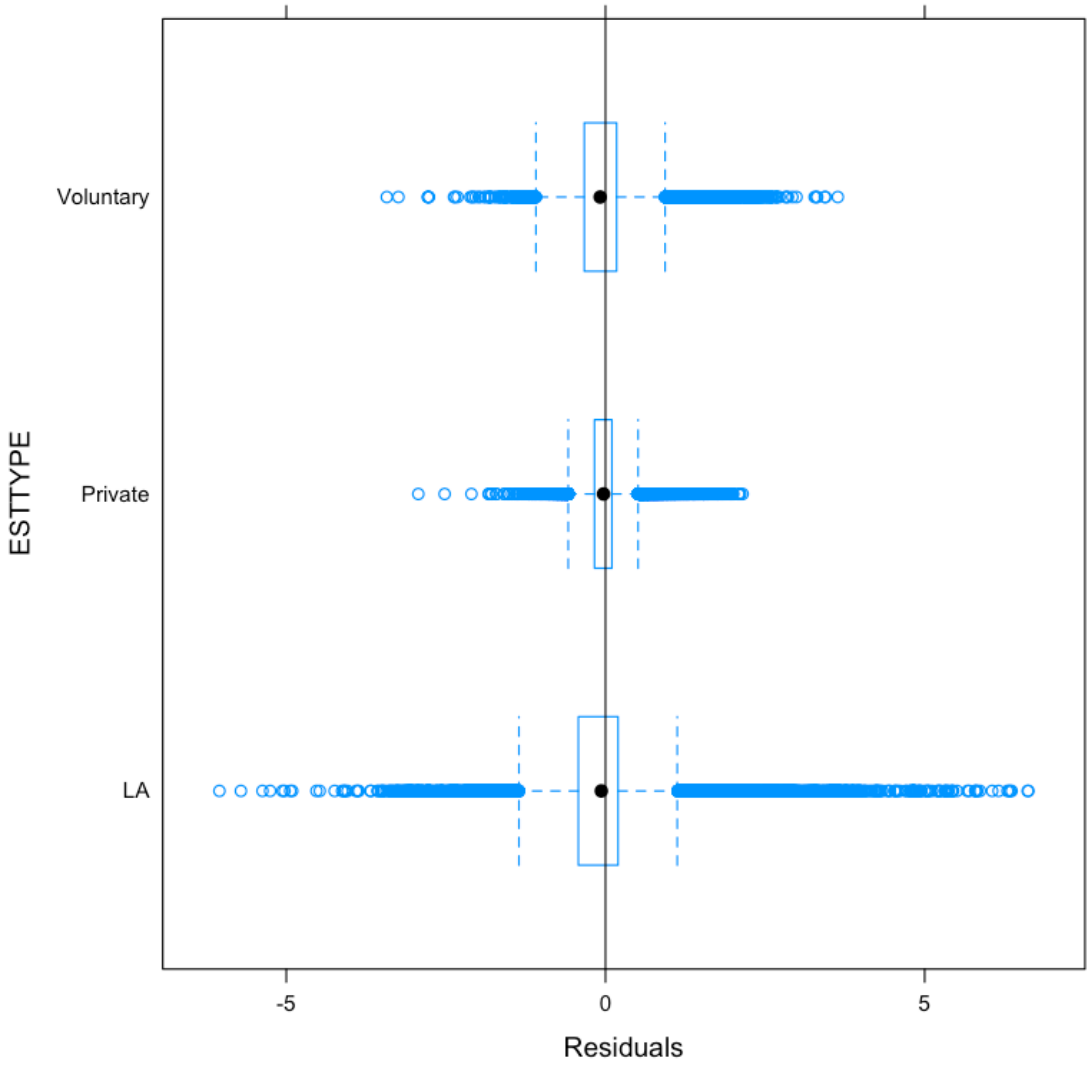
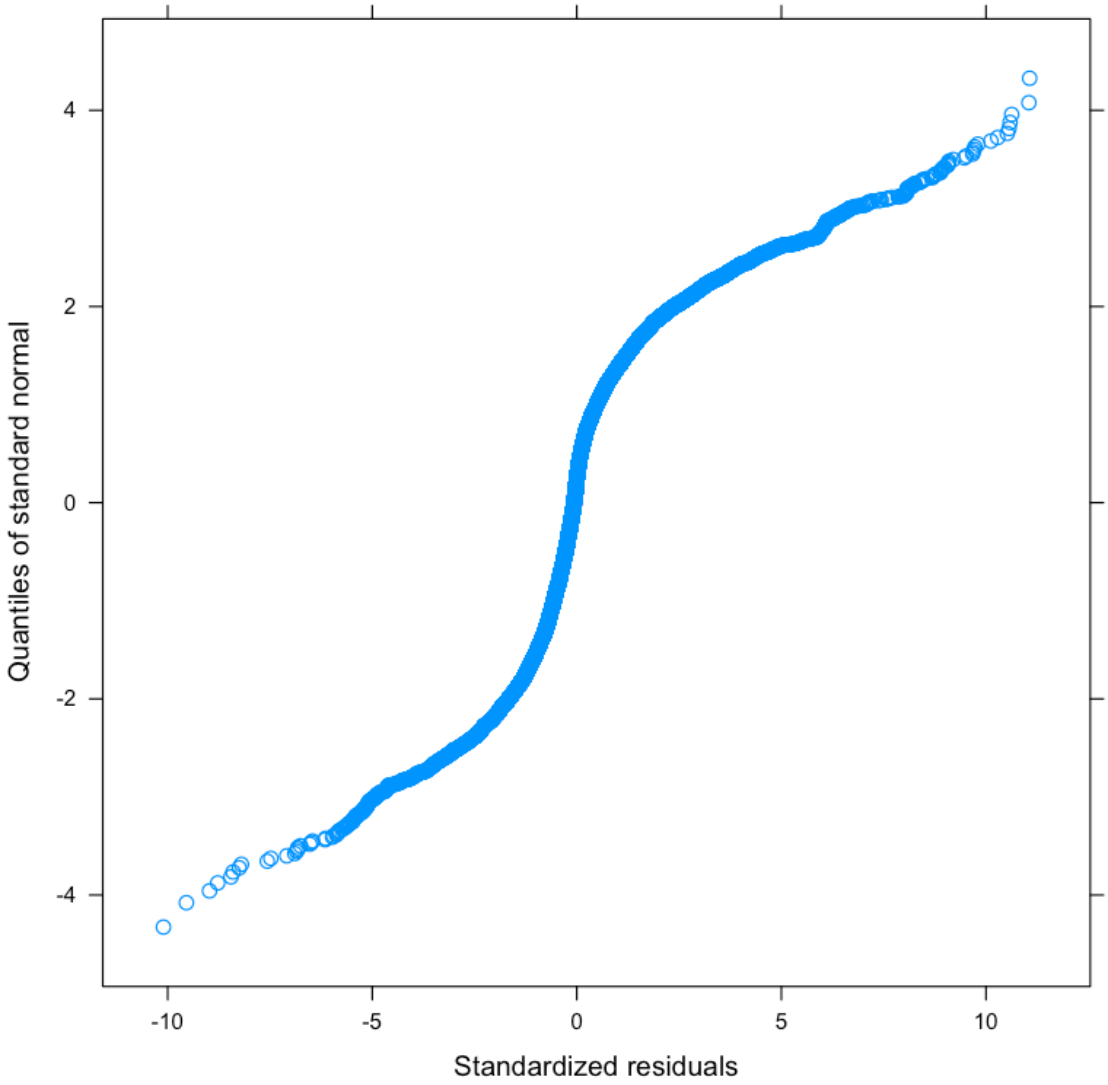


Figure 8 Final mixed-effect model for direct care workers' pay rates: residuals and fitted values plots



Appendix C

Residuals plots of the final mixed-effect model of managers'/supervisors' pay

Figure 9 Final mixed-effect model of hourly pay rate for manger/supervisor: distribution of residuals, centered around 0, by region (first random effect)

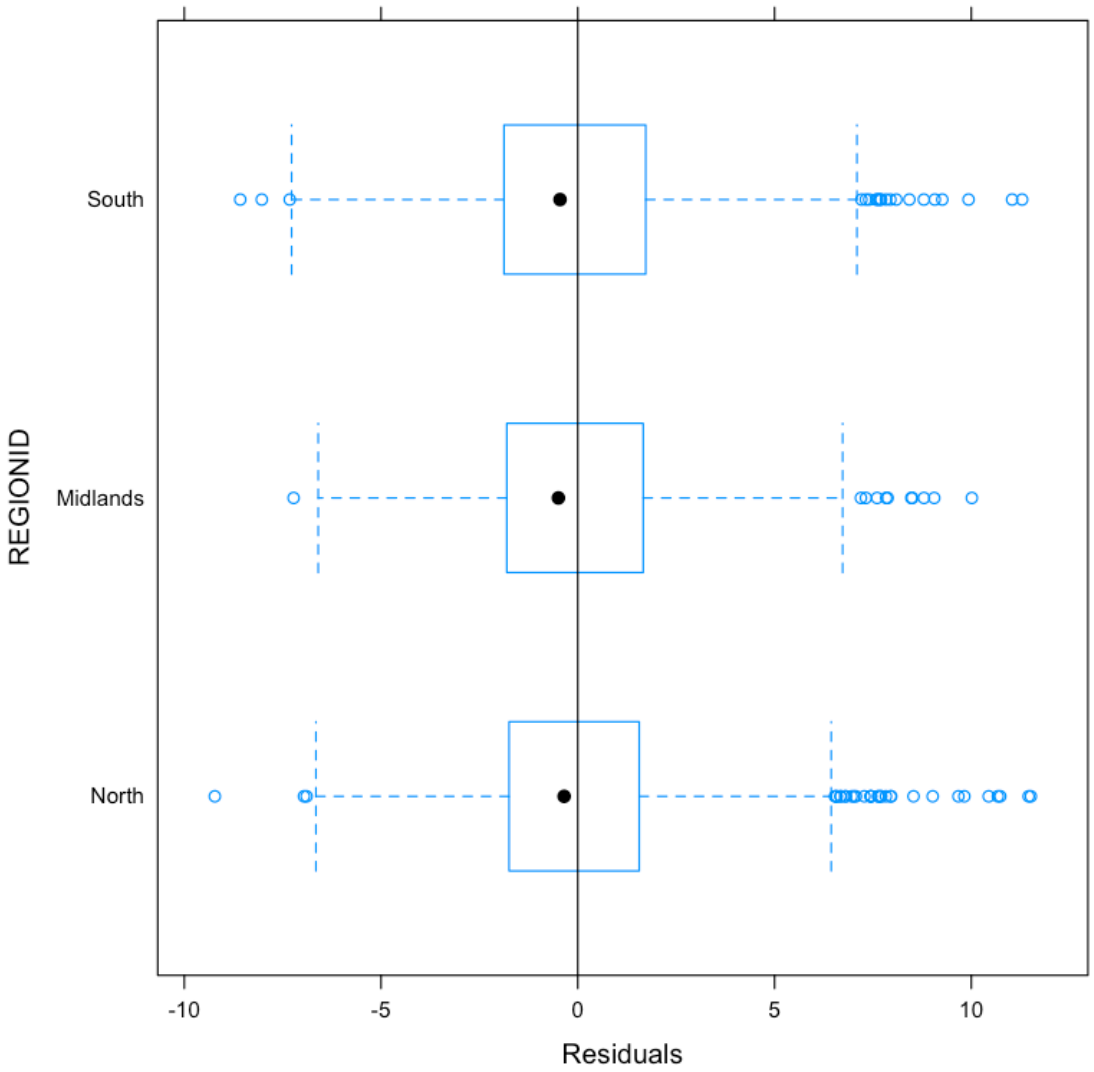


Figure 10 Final mixed-effect model of hourly pay rate for managers/supervisors: distribution of residuals, centered around 0, by sector (second random effect)

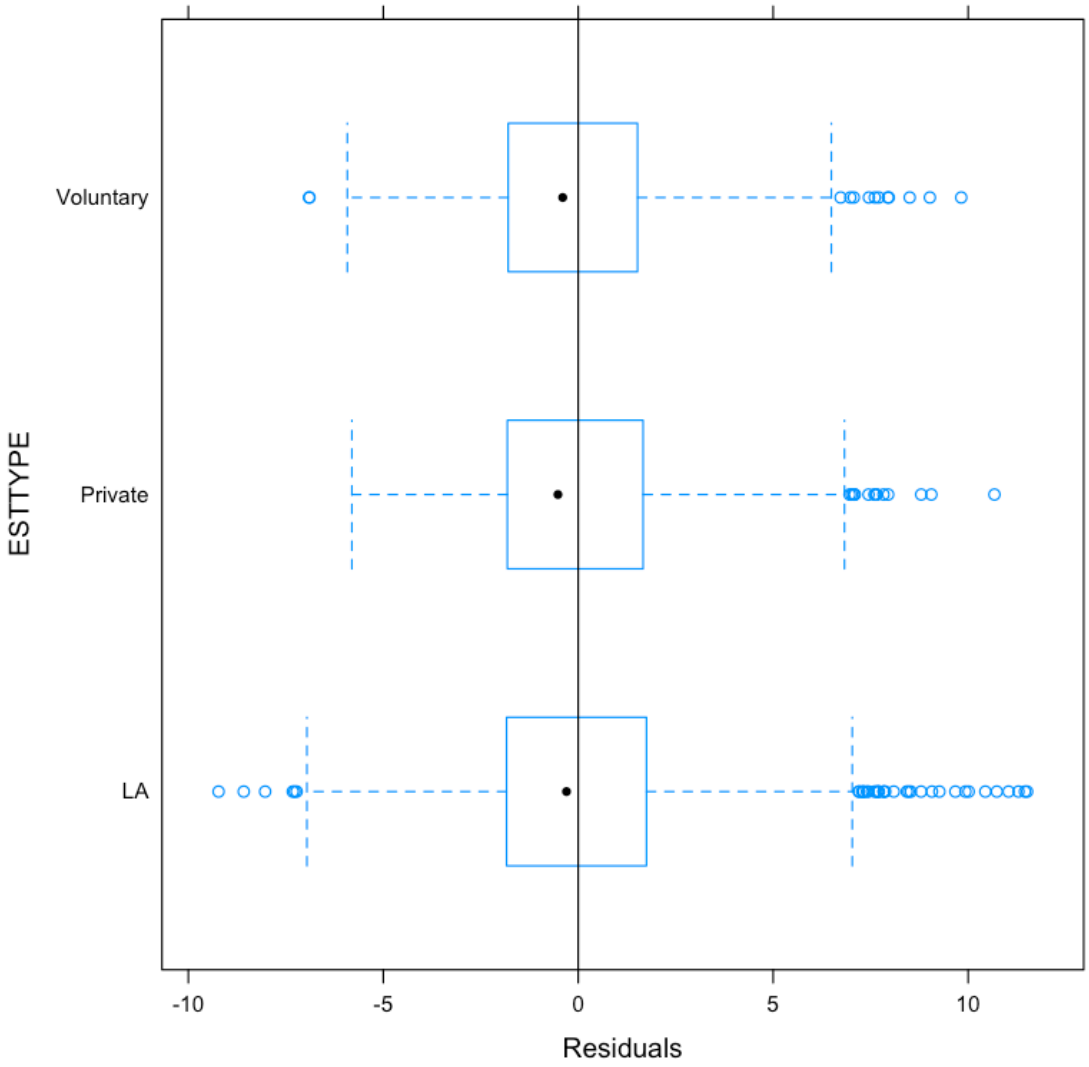
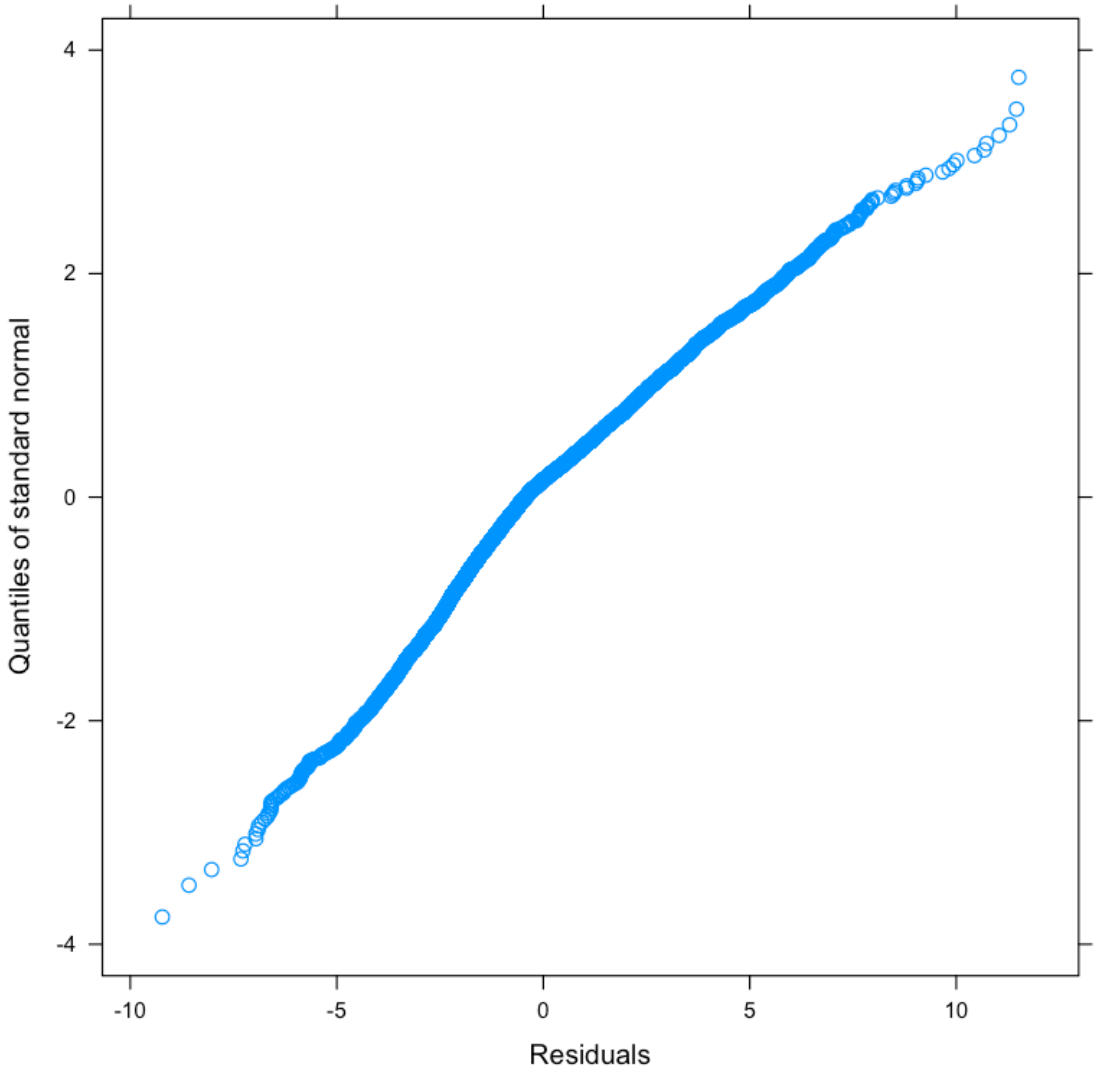


Figure 11 Final mixed-effect model for managers'/supervisors' pay rates: residuals and fitted values plots



Appendix D

Residuals plots of the final mixed-effect model of professional workers' pay

Figure 12 Final mixed-effect model of hourly pay rate for professional workers: distribution of residuals, centered around 0, by region (first random effect)

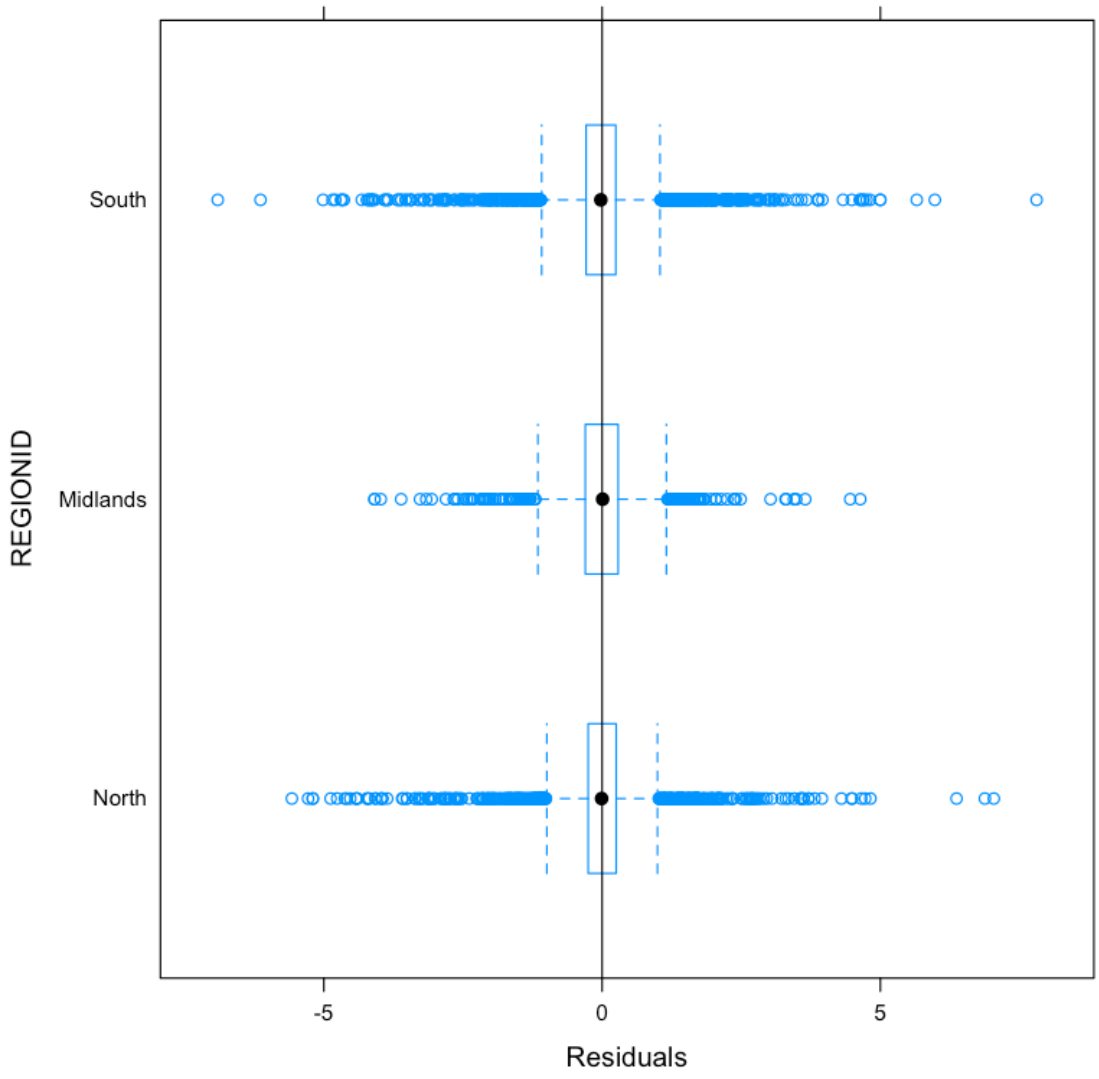


Figure 13 Final mixed-effect model of hourly pay rate for professional workers: distribution of residuals, centered around 0, by sector (second random effect)

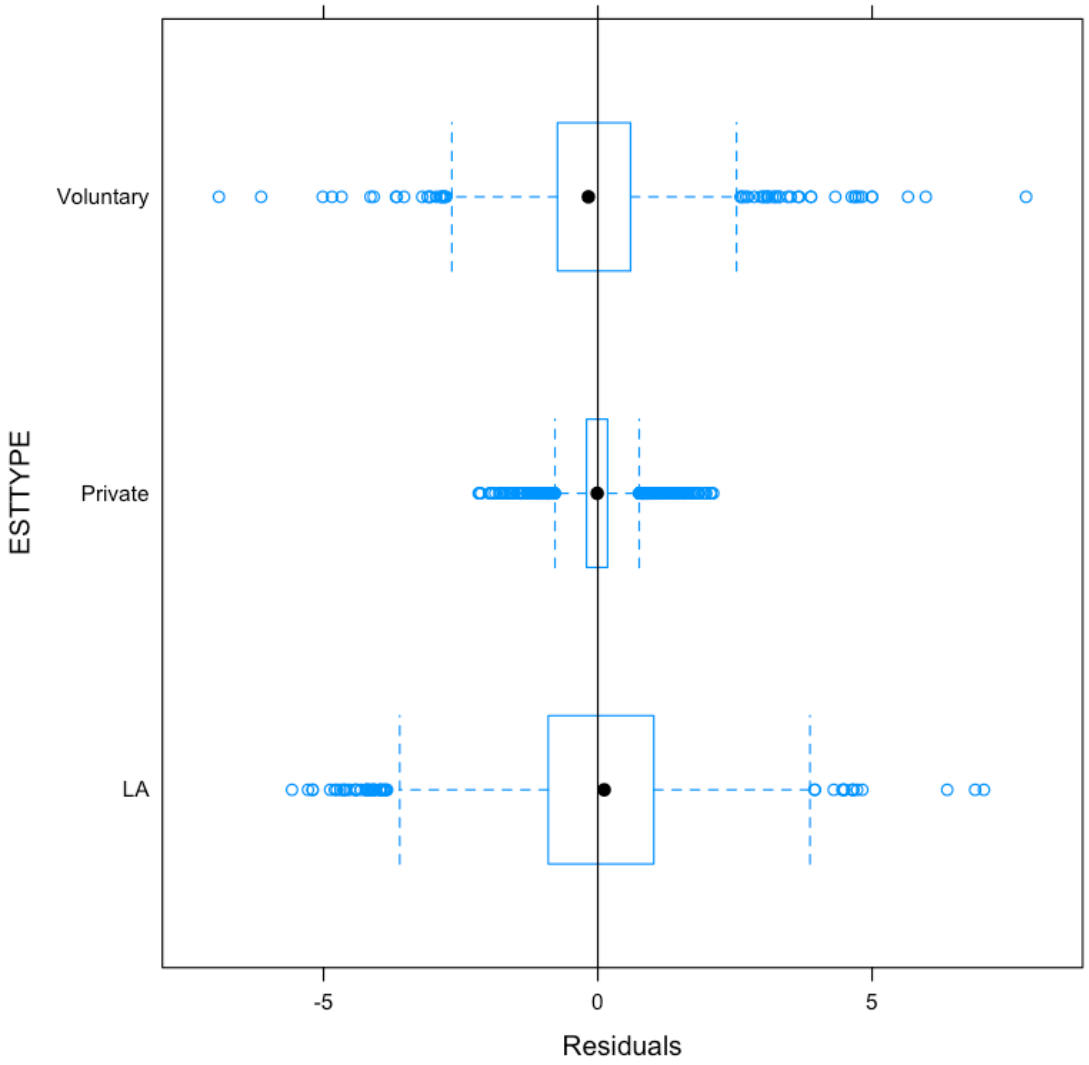
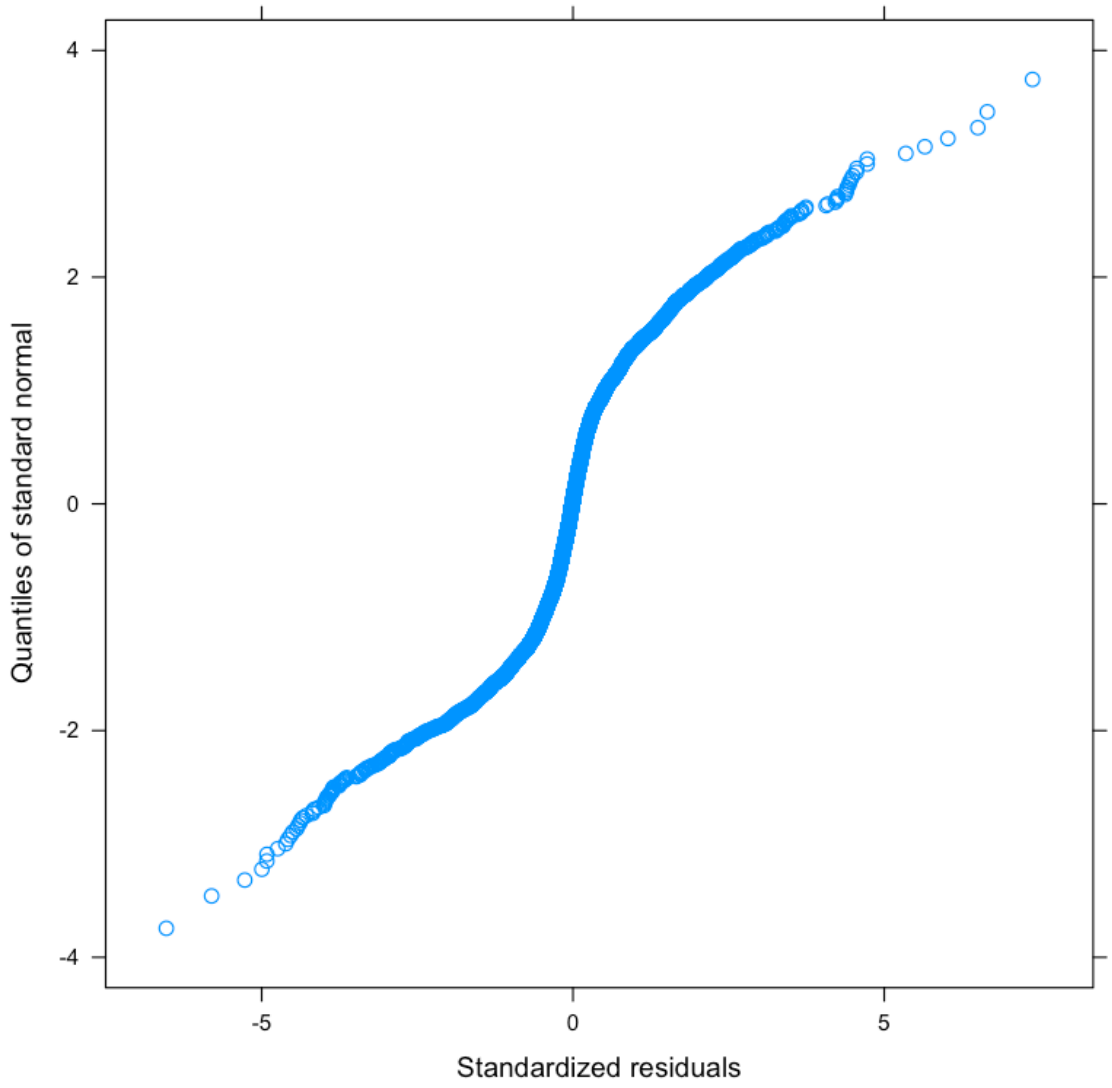


Figure 14 Final mixed-effect model for professional workers' pay rates: residuals and fitted values plots



Appendix E

Residuals plots of the final mixed-effect model of pay among workers with 'other' job roles

Figure 15 Final mixed-effect model of hourly pay rate for 'other' job roles: distribution of residuals, centered around 0, by region (first random effect)

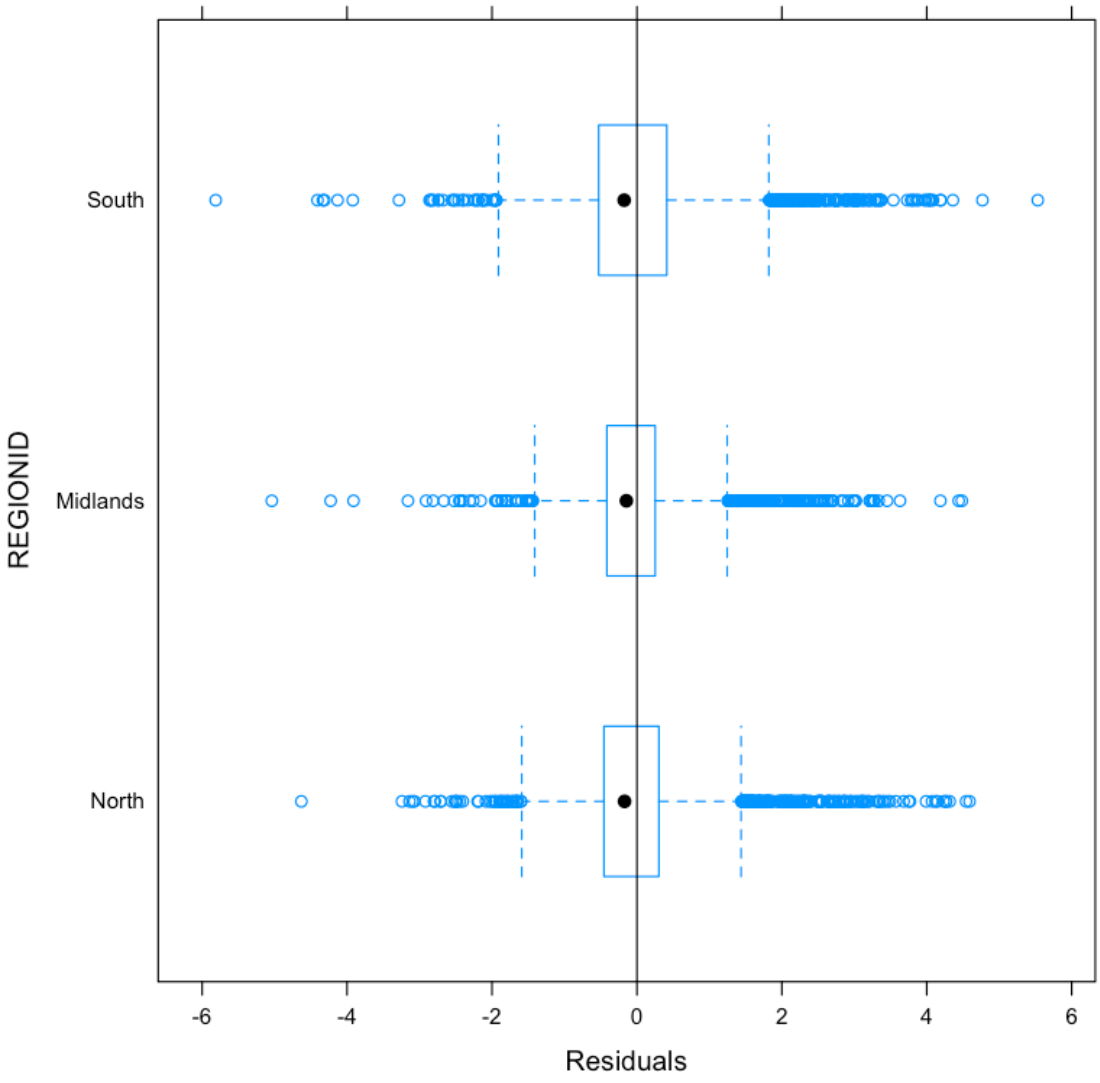


Figure 16 Final mixed-effect model of hourly pay rate for 'other' job roles: distribution of residuals, centered around 0, by sector (second random effect)

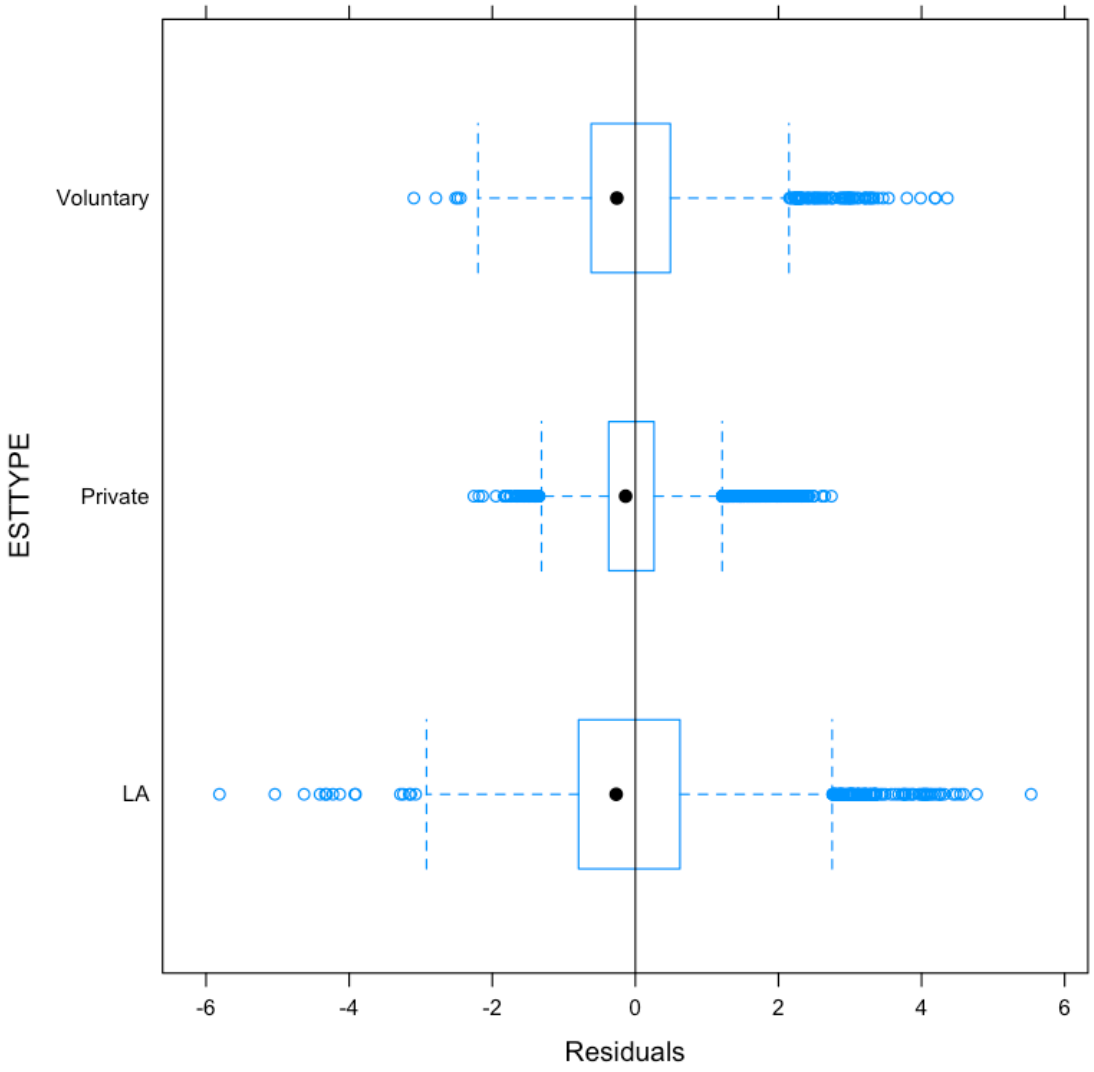
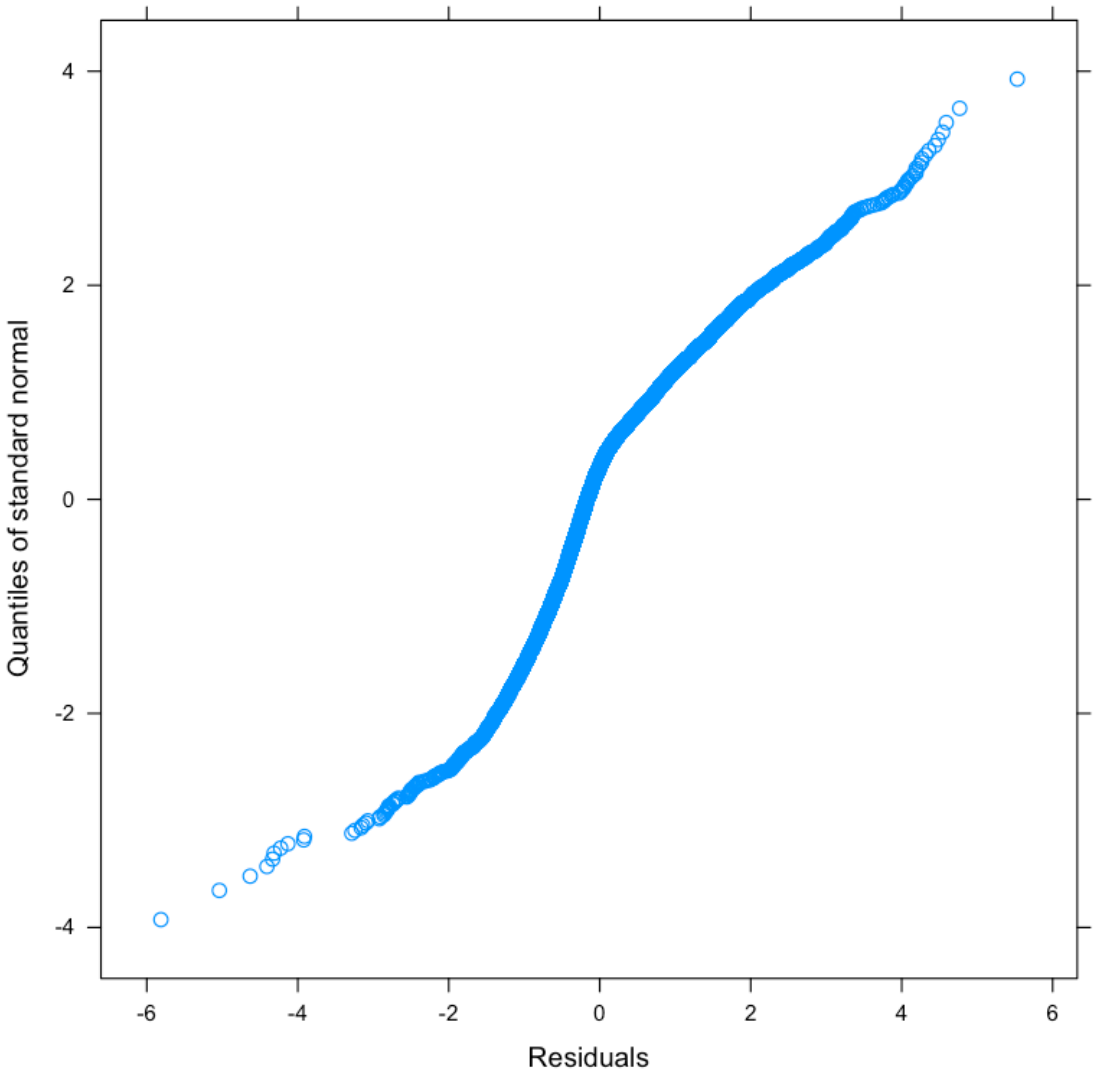


Figure 17 Final mixed-effect model for pay rates among workers with 'other' job roles: residuals and fitted values plots



About NMDS-SC

The NMDS-SC is the first attempt to gather standardized workforce information for the social care sector. It is developed, run and supported by Skills for Care and aims to gather a 'minimum' set of information about services and staff across all service user groups and sectors within the social care sector in England. The NMDS-SC was launched in October 2005, and the online version in July 2007; since then there has been a remarkable increase in the number of employers completing the national dataset.

Two data sets are collected from employers. The first gives information on the establishment and service(s) provided as well as total numbers of staff working in different job roles. The second data set is also completed by employers; however, it collects information about individual staff members. Skills for Care recommends that employers advise their staff they will be providing data through the completion of the NMDS-SC questionnaires. No written consent from individual members of staff is required, however, ethnicity and disability are considered under the Data Protection Act to be *'sensitive personal data'*, thus it is recommended that consent for passing on these two items needs to be explicit. For further details on NMDS-SC please visit http://www.nmds-sc-online.org.uk/

The NMDS-SC has provided the sector with a unique data set, providing information on a number of the workforce characteristics. However, it is important to highlight the emerging nature of the NMDS-SC, mainly due to the fact that data have not been completed by *'all'* adult social care employers in England, at this stage. Therefore, some of the findings may be under- or over-represented as a result of this. It is also equally important to bear in mind that data are completed by employers and not workers. This may also prompt some technical considerations when interpreting the findings. *Social Care Workforce Periodical* addresses such considerations in its discussions of findings.